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An Experimental Study of Belt Lacing.

BY WALTER FLINT, M. E.

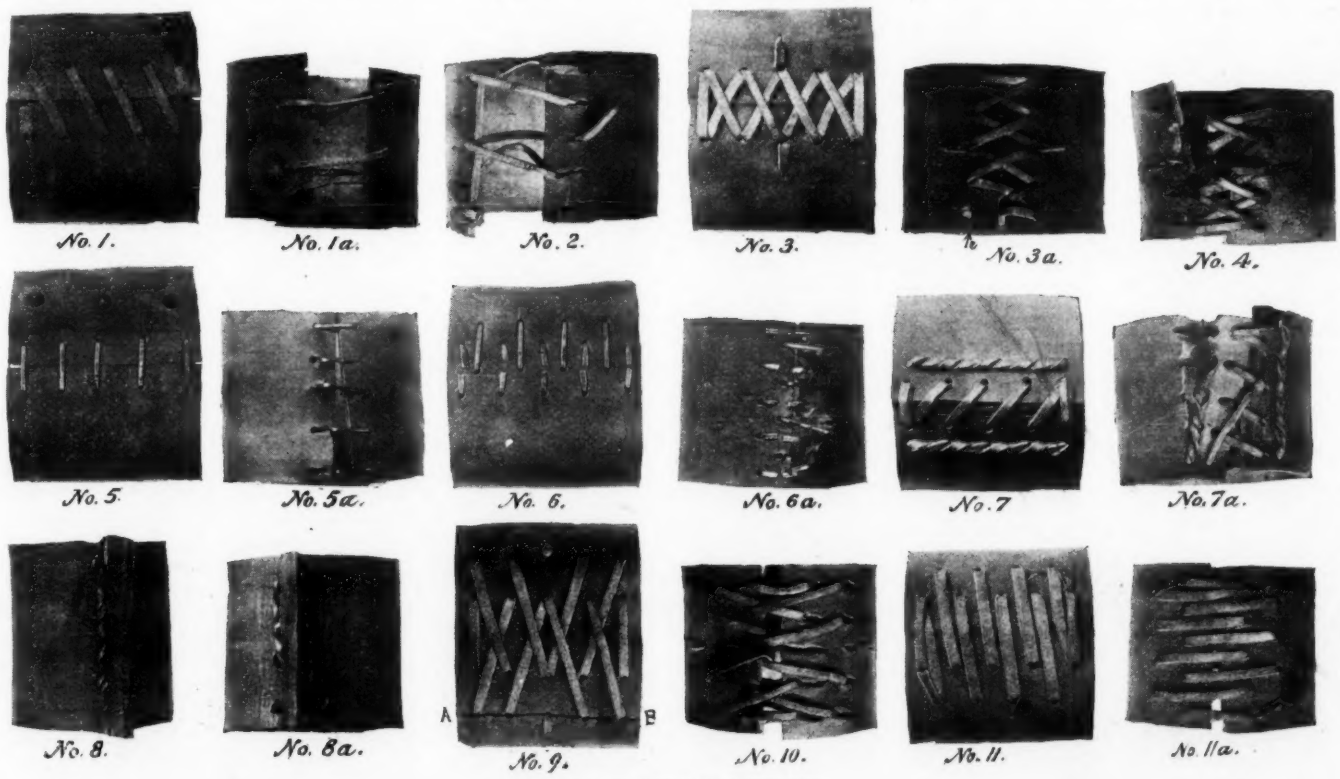
Every one who has had the care of belting has always had a decided preference for some particular form of lacing; and no doubt has ever existed in his mind that it was the best.

It is the object of this paper to demonstrate so far as possible, which of the most common joints is the strongest, *the question of wear not being considered.*

Another point to be determined is the efficiency of the round punched holes compared with the narrow slit cut with a belt awl. It is claimed by many practical men that holes made with the awl are better, because none of the leather is removed. Good reasons for doubting this theory have appeared, but no actual proof has been presented.

In making these tests, 4-inch belting was selected and laced thoroughly with ¼-inch lacing, well stretched. Five holes were punched ⅜ inch from the end for a single row of holes, and for a double row of holes the second row was 1½ inches from the end. The punched holes were $\frac{3}{16}$ inch diameter. These five holes removed $\frac{15}{16}$ inch from the width of the belt. The belt being 4 inches wide, the net section is about 76 per cent. of the solid belt, while in the cases where the holes were cut with an awl, the net section is theoretically about the same as the solid belt.

The apparatus for holding the specimens was so constructed that the belt was free to move as though it were on pulleys, thus equalizing the strain in that direction. It was then held in the testing machine by hooks, which allowed it to stretch more on one side than the other if it wanted to. This latter condition is not strictly true of a belt on pulleys, but considering the very short length of the samples it was thought best to have it so.



A STUDY OF BELT FASTENINGS.

No. 1 AND 1A.

The form of this joint is plainly shown in cut No. 1, and No. 1*a* shows the break. The belt was not injured. The lace broke in the middle first and then on the edge. The joint failed under a tension of 1,150 pounds.

Since the net section should hold about 2,065 pounds, it is clear that more lacing should be put in.

No. 2.

This is the same form of joint as No. 1, except that the holes were made with an awl. It was not thought worth while to photograph this one before testing. It will be noticed that the lace cut the belt from the holes in various directions. The lace did not fail till after the belt failed on the lower side.

The joint failed at 790 pounds, and the form of the break shows that the failure was due to the form of holes rather than weakness of belt.

No. 3 AND 3A.

Same number of holes and punched same as No. 1, but double laced, as shown in cut No. 3. The break is shown in cut No. 3*a*, at *c*. The lace was not broken.

Tension applied, 1,460 pounds.

No. 4.

Exactly the same as No. 2, except that it was double laced as No. 3.

Tension applied, 1,335 pounds.

It failed by the lace cutting through the belt. Shape of holes was cause of failure. The lace was not injured.

These tests would seem to show that holes cut with an awl are far inferior to punched holes.

No. 5 AND 5A.

This was a trial of one of the metallic fastenings. The fastenings being 1 inch long, the holes had to be made ½ inch from the end of belt.

No. 5*a* shows the broken joint.

Tension applied, 725 pounds.

Two of the hooks broke, one straightened out, one pulled through the belt and one remained sound, thus showing failure of both belt and fastenings.

No. 6 AND 6A.

Same as No. 5, except that by staggaring the holes four more hooks were put in.

No. 6*a* shows the broken joint which failed under a tension of 1,480 pounds.

Both belt and fastenings failed.

No. 7 AND 7A.

Cut No. 7 shows this form of joint. Holes punched. The break is shown in 7*a*, and took place at 1,510 pounds.

The lace failed in one place, while the belt failed generally.

No. 8 AND 8A.

This is known as the "boot leg" lacing, and is a great favorite in eastern Maine, because of its durability. Of course, it cannot be used with a tightener nor in many other places.

No. 8*a* shows the break which occurred in the lace; the belt itself had started to tear in several places on the inside.

Tension applied, 1,310 pounds.

No. 9.

This is a double-laced joint with only one strand in each hole. Holes punched. The negative of the broken specimen was lost, but the break occurred along the line *A B*. The lace was not injured. As near as could be observed the break was simultaneous along *A B*.

Tension applied, 2,015 pounds.

The net section of belt should have held about 2,065 pounds. This would seem to show that nothing further can be obtained when five $\frac{3}{16}$ inch holes are used, since the lace held more than the belt.

No. 10.

Same as No. 9, except that holes were cut with an awl. It was thought since No. 9 failed on account of too small a net section, that by making holes with an awl might possibly help matters. The cut shows the result. The lace was not injured.

Tension applied, 1,590 pounds.

No. 11 AND 11A.

No. 11 is peculiar in that the holes are staggered, one strand in each hole, and strands not crossing on either side. There appears to be no reason why it should not hold as much as No. 9. The lace was evidently faulty, since the holes did not appear particularly strained. No. 11*a* shows the broken lace on the lower side.

Tension applied, 1,835 pounds.

This comes the nearest to No. 9 in strength.

Maine State College, Orono, Me.

Molding Pump Plungers Without Anchors.

BY J. WEYHENMEYER.

The method illustrated in this article is in use for molding pump plungers in the shops of the Jeanesville Iron Works at Jeanesville, Pa.

Molding a plunger with one end solid *without anchors* has been an enigma to a great many foundrymen building pumps. The manner in which these plungers are cast will, I think, be approved by practical men as being simple and not easily improved, while its adaptability is unquestioned.

Fig. *O* is a section of the plunger casting to be made. It is cast larger than required, as shown by the dotted line *A A*, so that when finished it will be clean and solid at the top. The part above *A A* is cut off in the machine shop, and holes 9, 9, 9 are then drilled and tapped for bolting on the head that receives the piston rod.

In preparing to make a casting of this nature the molder will prepare the first or bottom piece *D* 1, which is about 6 inches high, with a bottom plate bolted on, as shown at *A*, Fig. 1, by filling it with sand full enough to allow for one layer of brick and a coat of loam; this done he will then set the pattern *B*, Fig. 1, on, which is about 24 inches long, with a bail *C* bolted on, to draw it out with. This pattern should be set central in the flask and perfectly plumb, the flask, of course, being level.

To mold plungers of different lengths it is necessary to have the flask *D* made in different sizes.

The flasks *D* being made interchangeable two pins *a a* will be put in and lifted over the pattern *B* on to the piece *D* 1 which has been prepared. The molder will then bolt these pieces together and proceed to ram up the flask to the top, when he will put on another section of flask *D*, making a joint at the top of this one, and continue drawing the pattern *B* upward until the mold is made the required length, and joint every other section.

When the mold is rammed up strike off the sand around the pattern at *E* about 1½

inches from the top of the flask *D* to receive the cores *F*. The mold now being ready to black and finish will be dried in the oven.

We will now explain the core barrel *G*, Fig. 2; it must necessarily be small enough to make the core at the neck *H*, and as many ropes as are required to make the core the proper size at *I*.

The core is swept up with the sweep *J*, Fig. 4; the barrel *G* you will observe has movable journals *K K*. The core being ready the molder rests both ends on wooden blocks, so that it will not slip in raising it. The journal and flange combined at the top end of the barrel is now removed, and the bail *L* is bolted on at *M*; the crane hook is then attached to the bail *L* and the core upended, the bottom journal resting continually on the wooden blocks until suspended.

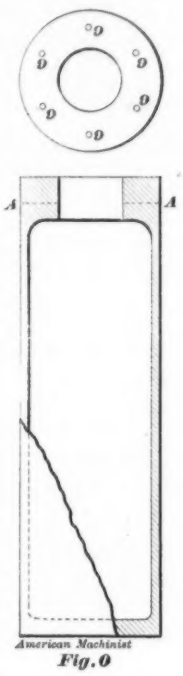


Fig. 0

The bottom journal *K* is then removed and the core shown at *N*, Fig. 4, which is made on an arbor *O*, Fig. 3, with a lug *P* threaded the same as the barrel at *Q* and screwed into the barrel. It will readily be seen that this closes everything up at the bottom of the core.

The molder having placed in the pit one or more sections of the mold bolted to the bottom piece *D* 1, he will place in the thickness block of wood shown at *R* for the core to rest upon, also four wooden wedges *S* standing on end in the bottom of the mold; these being in place the molder will lower the core into the mold until it rests on the block *R* and against the wedges *S*. He will continue placing the sections of mold over the core until the mold is the required length.

The core will then be centered on the top by placing one of the cores *F* against the center core, and ramming sand between the core *F* and the flask at *E* and putting one core in at a time until the four sections are in and the whole top is covered.

In order that the casting may be run clean eight ¾-inch gates *T*, Fig. 6, are made in the covering cores *F* in a position to allow the metal to drop immediately on the bottom and not strike the mold or core.

The bail *L* is removed, the runner box *U* placed in position and the runner finished.

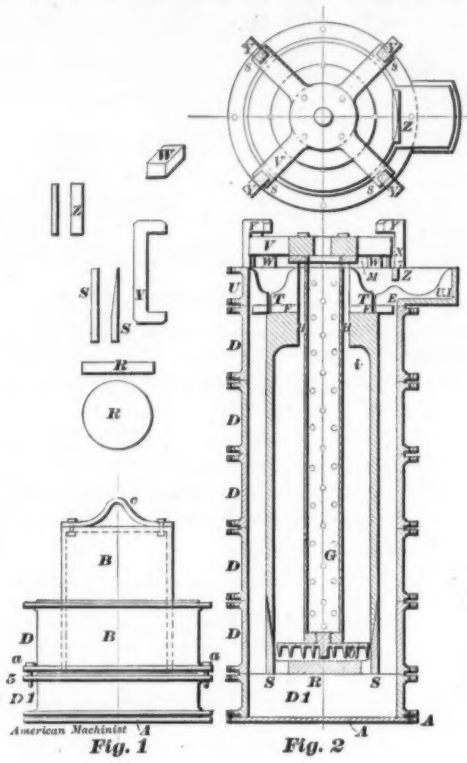


Fig. 1 Fig. 2

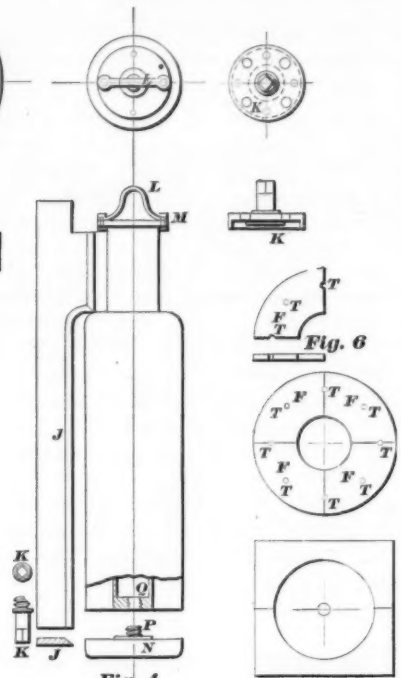


Fig. 4

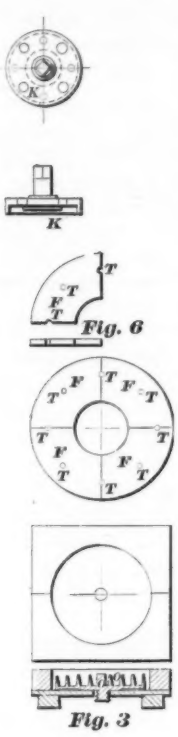
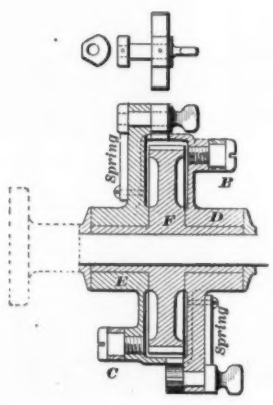


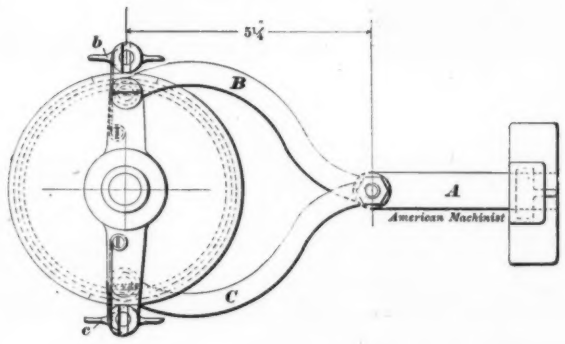
Fig. 6 Fig. 3

MOLDING PUMP PLUNGERS.

The cross *V* should stand above the flask about 2 to 4 inches to permit four iron blocks as shown at *W* to be placed one at each section of the cross at *X*, and an iron wedge driven just tight between the cross *V* and blocks *W*. The molder will then attach two grab hooks to the flange of runner box *U* and proceed to hoist the whole mold and core together from the joint 5, Fig. 1, when the wedges and block can be removed, and the joint cleared of dirt that has fallen down when making the runner *U* 1. Should the core be hanging out of center it can be centered by tapping the wedges at *X* enough to place it in the proper position.

Having the core perfectly centered he will then close the mold down finally, bolting the joint together, and preventing any possibility of the core rising by placing a clamp *Y* on each end of the cross and to one of the flanges of the flask, and wedging between the clamp *Y* and cross *V*.





The cross *V* will then be placed on the top of the core barrel bolted fast to the flange *M* with four ¾-inch bolts.

The mold is now ready for metal, which should be poured hot and quick. Fig. 3 is the box in which the bottom core *N* is made in. Fig. 6 is the covering core which is made in sections.

The core *Z* is a rectangular shape and is placed across the runner at 7 to prevent any impurities from entering the mold.

It is desirable to loosen the clamps at 8, Fig. 1, as soon as practicable after metal in the runner is set; this to permit the expansion of core barrel, which would otherwise crack the solid end of the casting.

To remove the core barrel from casting revolve it sufficiently to enable it to free itself from the arbor *O*, Fig. 2, when it can easily be withdrawn. *O* can be broken and removed with the loose core sand.

To secure the core from any possibility of being unable to sustain its own weight, especially at its greatest diameter, a number of wooden pegs may be placed in vent holes of core barrel and driven tight prior to placing the rope on; this will prevent any tendency of the core to slip.

Jeanesville, Pa.

New Surface Grinding Machine.

We present herewith two general views and a detail of a new surface grinder, the general construction of which will be readily understood from the engravings. The machine rests upon a base, the plan of which is T-shaped, one arm of this base supporting a bed resembling a lathe bed upon which the platen moves.

A shorter bed upon the other arm of the base supports a head having a vertical housing, to which the saddle carrying the wheel spindle is fitted.

The spindle is large in proportion to size of wheel used, runs in large bearings, and is supported at the outer end from an overhanging arm, as shown.

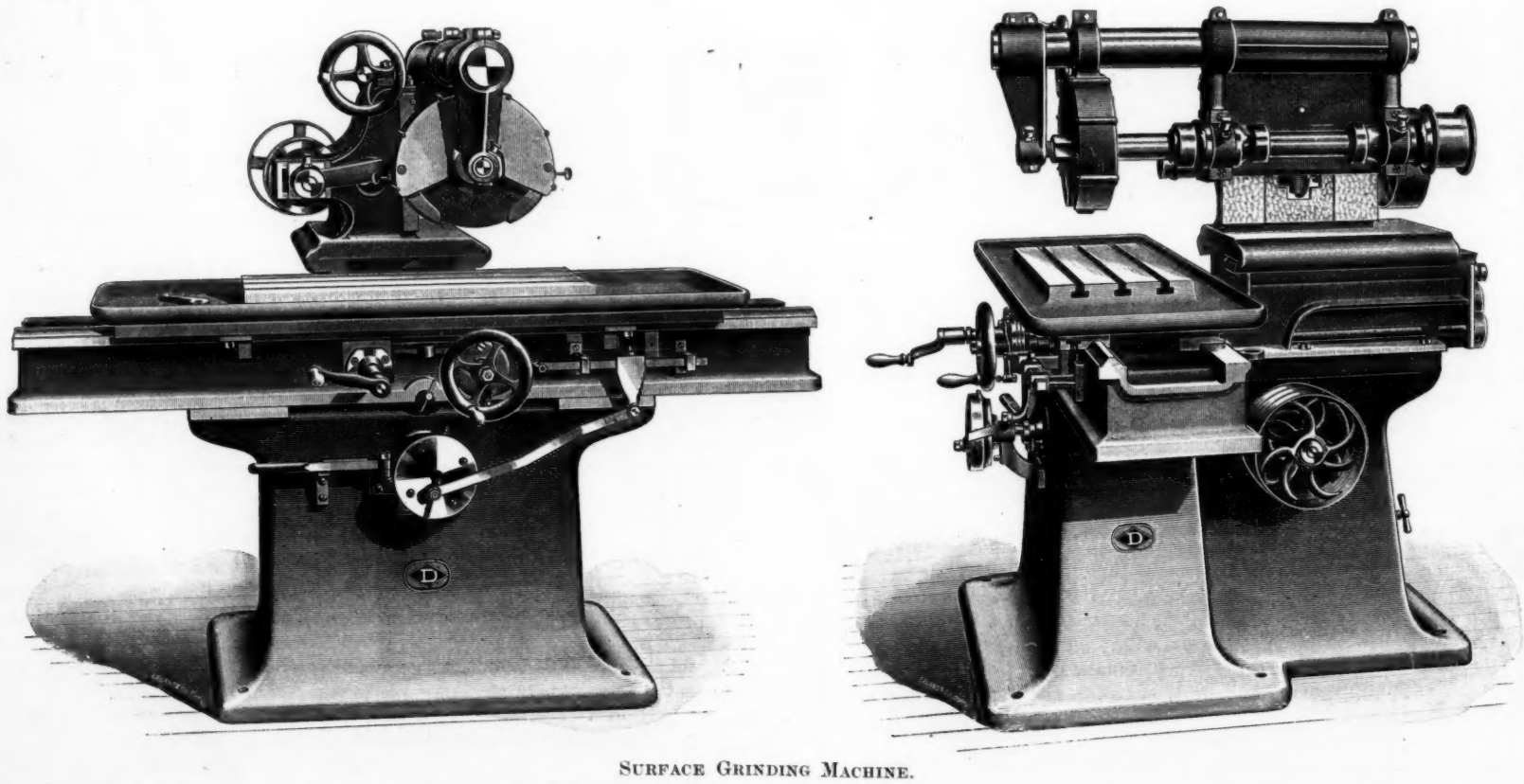
The hood, which is supported from the overhanging arm, is provided with means of running water onto the wheel if desired, and the platen is designed to take care of the waste water. A pump is furnished, if desired.

The wheel is moved vertically by means of the upper hand wheel, which is provided with micrometer graduations, and the short horizontal belt which drives the spindle is kept at a uniform tension by connecting the shaft from which it is driven to the spindle support by links, one of which is seen in the front view of the machine. The boxes for the countershaft are fitted to slots which allow them to move horizontally as the wheel is moved vertically.

The wheel is moved horizontally either by hand (by the lower hand wheel) or automatically at the end of the movement of the platen, as may be desired. The platen is guided by one V only, resting upon a flat surface at the back, and its movement is sufficient to enable the machine to grind true the entire platen surface.

Adjustable dogs reverse the motion at any desired point, and in doing so move a square bar seen in front of the machine below the platen and marked *A* in the detail engravings. To the left-hand extremity of this bar are attached two curved connections, *B* and *C*, the other extremities of which are connected to the oscillating plates *D* and *E*, which are journaled upon and freely turn upon the hub of the notched disk *F*, which is keyed to the cross-feed screw.

On the disks *D* and *E*, at points diametric-



SURFACE GRINDING MACHINE.

ally opposite the connections referred to, are the double pawls *b* and *c*, either or both of which can be thrown into action in either direction, so that the wheel will thus be fed across the bed in either direction, being advanced either at one end of the platen travel only or at both ends, as may be desired.

Various sizes of the machine are built, the one shown being for wheels up to 12 inches diameter, 2 inches face. It has a table 48 inches by 12 inches, and takes work 9 inches high under a 12-inch wheel. Spindle is 2¼ inches diameter with bearings 6 inches long.

The machine is built by the Diamond Machine Co., Providence, R. I.

Shop Notes—Drop Forgings.

An AMERICAN MACHINIST man, who recently visited the shops of the Billings & Spencer Co., at Hartford, found them quite busy, especially on bicycle parts and bicycle wrenches, about 125,000 of the latter being the production for this year. The electrical interests also contribute their share of business, as is shown by the fact that about 35 tons of pure copper per week were being made into drop-forged commutator bars, varying in size from the smallest, weighing

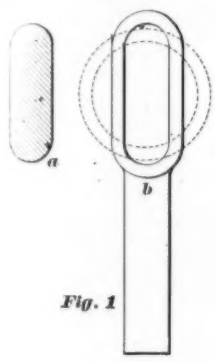


Fig. 1

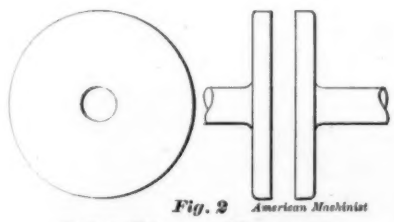


Fig. 2 American Machinist

DROP FORGING METHODS.

a few pennyweights, and used on phonographs, to the largest for the dynamos put in at Niagara, where each bar weighs about 25 pounds.

The demands of the cycle makers for new styles of wrenches, and lots of them, have led to the introduction of a number of new methods in their manufacture, and one among the most interesting of these is illustrated by Fig. 1, which represents the sliding jaw of one style of bicycle wrench. The bar of this wrench is shaped as shown by the cross section at *a*, which is about its actual size. For a time the slot through the sliding jaw *b* to fit this bar was made by drilling a series of holes of a diameter equal to the thickness of the bar, and then broaching out the metal left by the drills. It is now done by an entirely different and novel method, as indicated by the dotted circles at Fig. 1, the larger circle indicating the form of the piece as it leaves the drop hammer, and the smaller one the single hole which is drilled through it. This hole is then filled with a plug of babbitt metal, which is $\frac{9}{16}$ inch diameter, and 1⅛ inches long. These plugs are cast in a device resembling in principle the old-fashioned bullet molds, only there are holes in it for casting about a dozen plugs at once, the metal being poured into a runner that communicates with all of them.

This jaw with the babbitt metal plug in the hole is then taken to a drop hammer and flattened out, cold, to the form indicated by the full lines; the die in which this is done being the proper shape for the outside of the jaw, and the only function of the babbitt metal being to insure that the piece is at all points forced out against the impression in the die, which insures also that the hole shall be the right size and shape. The surplus alloy is forced out at each end of the piece in the form of a fin. The soft metal is then removed by melting it out in a pot of similar metal heated, a few seconds' immersion in this melted metal doing the work thoroughly, and the hole is then finished by forcing a smooth broach through it.

Another operation on these wrenches will be understood by reference to Fig. 2, which shows the arrangement of two grinding disks, the one to the left being mounted in a head in the ordinary way, while the other one is upon a spindle that has an endwise sliding motion through its boxes. Between them is placed a very thin rest to support the work, which is held in a pair of tongs between the disks, which are then brought together upon it, so that both sides are ground simultaneously and parallel to each other. The disks are of cast-iron, covered with emery paper, or cloth, and the device forms an exceedingly efficient means of grinding opposite surfaces parallel and to gage.

For annealing forgings a method is in use here that is the invention of Mr. H. K. Johnson, superintendent of the Russell & Irwin shops at New Britain, Conn.

The apparatus consists, in the B. & S. shops, of two pieces of 8-inch steam pipe, about 6 feet long. These are closed at the ends by caps, one of which has a nipple in it, to which is attached a small rubber hose carrying ordinary illuminating gas from the city mains. The cap at the other end has a small cock which can be opened.

The work to be annealed is put into these tubes until they are filled, and the tube is then closed tight and the gas turned in until all the air is driven out, which is shown by the fact that the jet of gas issuing from the small cock at the other end of the tube burns steadily. This cock is then closed, and the communication to the gas pipe being left open, the tubes are placed in a furnace which heats them and their contents to the required degree, and then allows them to cool off very gradually.

Work which is polished bright before being heated in this way is just as bright afterwards, and the process will even remove the black oxide (scale) from forgings, leaving them white or gray.

Mr. Billings, who started in life as a machinist and tool maker, was speaking of the development of drop forging and its comparative newness as an industry. He said: "In the period between 1856 and 1860 I was at Colt's armory, and saw the first practical drop operated. Afterwards, in 1861, they were adopted at the U. S. armory at Springfield, and in the same year I put in a plant of drop-forging machinery, and contracted with E. Remington & Son, of Ilion, N. Y., to furnish them with 280,000 sets of drop forgings for their army pistols."

That was a very large contract for those days, and would not be despised even now, when the magnitude of the business is to some extent indicated by the fact that in the die room of the B. & S. Co. there are at present something over 300 tons of finished dies, all of which are what is known as live dies, *i. e.*, dies that either are frequently used, or are likely to be used again, the regular practice being to weed out those which are unlikely to be again used, plane them off, and cut a new impression in them for another job.

For the Springfield armory above referred to, Mr. Billings has recently designed and built what is believed to be the largest drop hammer ever constructed—certainly the largest ever built in this country. The hammer head is forged wrought-iron, and weighs, finished, 1,200 pounds, the anvil weighing 15 times as much, or 9 tons. A second hammer of the same dimensions is now being constructed for the same armory.

Plates of Uniform Strength.

BY ALBERT E. GUY.

SECTION 12.

RIBBED PLATES—CONTINUED.

It remains now to determine the shape of the rib. Figs. (22), (23) and (24) represent respectively half a top view, a diametral section, and part of the development of a section, along a circumference of radius x, of the cylinder bottom. It is thus seen that the structure is composed of T-sections. Dividing by 12 the bending moment about any point of the radius, the problem consists in finding the hight d of the rib.

The bending moment for any radius x is (equation 16, section 2):

$$M = 0.2929\,\pi\,x^3\,p.$$

Equating this to the moment of resistance of the section, we have

$$(116)\quad \frac{0.2929\,x^3\,p}{12} = f\,\tfrac{1}{6}\,.\,b\,d^2 - b_1\,d_1^2 - \frac{4\,b\,d\,b_1\,d_1\,(d-d_1)^2}{b\,d^2 - b_1\,d_1^2}.$$

In the expression of the moment of resistance of the section we have two known quantities: b and b_1; d and d_1 are unknown, and generally when it is required to find the moment of inertia of such a section, the method of successive approximations is used. The dimensions d and d_1 are guessed at and a first approximation is obtained; then d and d_1 are increased or reduced, according to the conditions, and another approximation is had, and so on, if the work is worth the time spent on it, until satisfactory values of d and d_1 are found. Most generally, in cases similar to the present one, the thickness of the top flange is equal to that of the rib. Consequently

$$b = \frac{2\,\pi\,x}{n}\,;\quad b_1 = b - h \text{ and } d_1 = d - h.$$

This reduces the unknown quantities to one, viz., d.

We may write equation (116) in the more convenient form:

$$(117)\quad a = b\,d^3 - b_1\,d_1^3 - \frac{4\,b\,d\,b_1\,d\,h^2}{b\,d^2 - b_1\,d_1^2}$$

In studying the figure (24) we see that $b + d_1 = b_1 + d$ = a certain sum which we may call m. Hence

$$m - b = d_1,\ (m-b)^3 = d_1^3,$$
$$m - b_1 = d,\ (m-b_1)^3 = d.$$

These values substituted in (117) give, after obvious reductions,

$$a = (m^3 - b\,b_1)\,h - 4\,b\,b_1\,h\left(\frac{m^3 - (b+b_1)\,m + b\,b_1}{m^3 - b\,b_1}\right).$$

Finally we obtain

$$m = d + b_1 = \sqrt{\frac{a}{h} + k\,b\,b_1}\,;$$

$$(118)\quad \text{whence } d = -b_1 + \sqrt{\frac{a}{h} + k\,b\,b_1}.$$

The coefficient k takes the place of an irreductible fraction, and a series of its values is given herewith corresponding to different ratios of d to b:

$\frac{b}{d}$ =	2	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1 2	1 1	1	0.9	0.8	0.7	0 6	0.5
k =	1 78	1 81	1 85	1.89	1.93	1.98	2.04	2.10	2.16	2.24	2.32	2 42	2.54	2.68	2.84	3.04

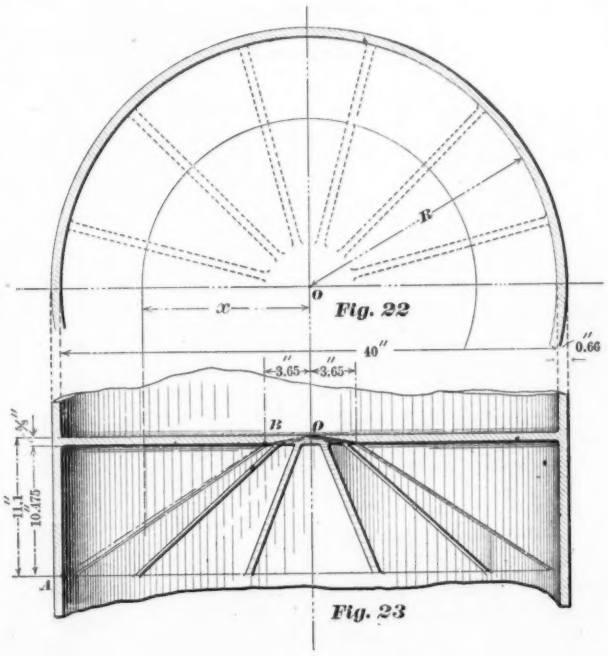


Fig. 22

Fig. 23

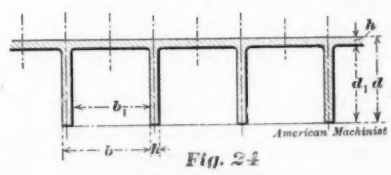


Fig. 24

RIBBED PLATES.

When the hight d is required, the simplest way to proceed is as follows: Since a, b, b_1 and h are known, it will be found convenient to employ in (118) a coefficient $k = 2.5$; a value d_0 of d will thus be determined, and with it the real coefficient approximated and introduced in the formula. In any case, two operations at least will be necessary to obtain d.

Let us find the greatest hight of the ribs of the cylinder cover:

$$a = \frac{0.2929\,\pi\,p \times 6}{12\,f} \times x^3.$$

p = 100 pounds per square inch;
$x = R$ = 20″ radius; the stress f = 3,000 pounds per square inch.

Substituting in formula (118) for the symbols their value, and following the above instructions, we have:

d = 11″ $\frac{1}{16}$ and d_1 = 10″.475.

As for the shape of the ribs, the writer has found by calculation that line $A\,B$ is a straight line. In consequence thereof the following rule may be established:

Rule.—For a given circular plate firmly fixed along a circumference of radius R (Fig. 23) and provided with a number of radial ribs whose thickness is known. First.—Find their greatest hight d_1 from equation (118$_1$):

$$d_1 = -b + \sqrt{\frac{a}{h} + 2.5\,b\,b_1}.$$

Second.—Find distance B o from equation (20), section 2, viz.:

$$B\,o = x = \sqrt{\frac{1.138\,f\,h^2}{p}}\,;$$

(in our case x = 3″.65), *in which f, h and p are known; then draw a straight line joining A and B, and the shape of the rib is thus determined.*

This form of ribbing may be objected to by some designers as being awkward; furthermore, because of the necessary great depth of the ribs, it may not be convenient to produce the wall of the cylinder far enough down to accommodate them.

The depth of rib may be reduced somewhat by adopting another shape, *i. e., making the rib of uniform depth diametrally.* This is less economical than the first manner. In order to establish proper formulæ, however, the plate of *uniform thickness* must first be calculated.

It has been shown in paragraph 9* that a circular plate of radius R supported, not fixed at the edge, and sustaining a uniform load p per unit of area, is composed of two

*See AMERICAN MACHINIST, November 15, 1894.

parts, viz., one of even thickness having for diameter $2 \times 0.7071\ R$; and another of varying thickness surrounding the former. It is very easy to deduce from that the rules governing the plates fixed at the edge and of even thickness.

When a plate of radius R is placed concentrically upon a circular support of radius $r_0 = 0.7071\ R$, and is uniformly loaded, the inner portion may be considered as firmly fixed at the line of support; then the bending moments about this line of junction of the two portions of the plate are equal, as is explained fully in paragraph (8). The bending moment concerning the annular portion is:

$$\text{(Eq. 87.)}\quad M = \pi p (R^2 - r^2) x = f \frac{\pi}{8} r h^2.$$

h is the maximum thickness of the annulus and the even thickness of the inner plate.

But for a plate whose flat portion has a radius $= R$, we have:

$$\frac{R_0}{R} = \frac{R}{r} = \frac{R}{0.7071\ R};$$

whence R_0, the diameter of the total plate, $= 1.4142\ R$. The value of x for $r = 0.7071\ R$ is 0.16, and for $R = 0.7071\ R_0$.

$$x = 0.16 \times 1.4142 = 0.226272.$$

Hence the bending moment for the annular portion is,

$$\text{(119)}\quad M_0 = \pi p \left(\overline{1.4142}^2 R^2 - R^2\right)$$

$$0.226272\ R = f \frac{\pi}{8}\ R h^2;$$

and the thickness,

$$\text{(120)}\qquad h = R \sqrt{0.6788 \frac{p}{f}}.$$

This is nearly the value found by Professor Grashof, viz.:

$$h = R \sqrt{\frac{2}{3} \cdot \frac{p}{f}},$$

and generally adopted in practice for plates fixed at the edge and uniformly loaded.

We may now employ the expression (119) of the bending moment for determining the size of the ribs of uniform depth, because the rules applying to the full plates apply also to the ribbed ones.

We may write:

$$\frac{6 \times 0.226272 \times \pi p R^3}{12 f} = a,$$

$$\text{or } \frac{6 \times 0.226272 \times 3.1416 \times 100 \times 8{,}000}{12 \times 3{,}000} = 94.78.$$

This value is introduced in equation (118) where b and b_1 have the same value as before, and we obtain

$$d_1 = -10.472 + \sqrt{\frac{94.78}{(\frac{1}{8})} + K\ (10.472 \times 9.847)}.$$

Finally in round numbers

$$d_1 = 9\tfrac{1}{8}'', \quad d = 9\tfrac{1}{8}'' + \tfrac{1}{8}'' = 9\tfrac{2}{4}''.$$

Remark.—Because of the lack of convenient formulæ some designers have been tempted to consider a rib of uniform depth as a solid fixed at both ends and uniformly loaded; that such a method is producive of excessive results is shown by applying it to the present case. The plate is supported by 12 radial ribs or their equivalent, *i. e.*, 6 beams fixed at both ends, and whose maximum bending moment is

$$M_{max} = \tfrac{1}{12} P L = f \frac{b d_1^2}{6}.$$

$$P = \frac{\pi R^2 p}{6};$$

$p = 100$ pounds; $f = 3{,}000$ pounds; $L = 40'' = 2\ R$; $b = \frac{1}{8}'' =$ thickness of beam; d_1 is the unknown depth of the rib.

$$\text{Hence } \frac{3.1416 \times 400 \times 100 \times 40}{12 \times 6} = 3{,}000 \times \tfrac{1}{8} \cdot \frac{d_1^2}{6}.$$

$$d_1 = \sqrt{\frac{3.1416 \times 400 \times 100 \times 40 \times 8}{12 \times 3\,000 \times 5}}$$

$$= 14''.94 \text{ or nearly } 14\ ^{15}\!/_{16}.$$

By comparing this result with those obtained previously it is evident that this method is incorrect and should not be used.

Some Special Tools in the Cincinnati Milling Machine Company's Shops.—II.

By John Randol.

SOME DRILLING JIGS.

In the way of drilling jigs, two examples are shown in Figs. 9 and 10. Fig. 9 shows a very neat little jig for drilling holes in hubs; the hub arbor *A A*, Fig. 9, is simply clamped in a V-groove in the top of the shelf by means of the "turn-around" strap *B*, secured by the clamp screw *C*. *D* is a thumb screw which holds the drill bushings in place. All the drill bushings used with this jig are provided with "not in use" seats in the base of the jig, as clearly shown in Fig. 9, so that when the jig is taken out of the tool room all of its drill bushings came with it, on a single check.

Fig. 10 shows a cone jig, in which the bush holder, *J J*, is slotted on the vertically adjustable piece *B*, so that the bush is adjustable horizontally and vertically; the body of the jig forms a quite heavy casting, as clearly shown, and is made readily portable by being placed on a wood-bed trolley, which is also fitted with a wooden side block provided with holes to take all the different arbors needed with this jig; the bushes not in use are provided with seats in the base same as in Fig. 9. These are two very convenient combinations, and can be copied to advantage. The general idea of their construction is to unite several pieces, commonly separate, in one portable structure, so that all may be kept together at all times, thus saving the workman the labor needed to collect what he wants for the particular job in hand. The arbors shown in Fig. 10 have tap clearance holes in them, so that with a right-and-left drill-spindle rotation the holes can be tapped in a lot of cones after drilling on this same fixture very rapidly.

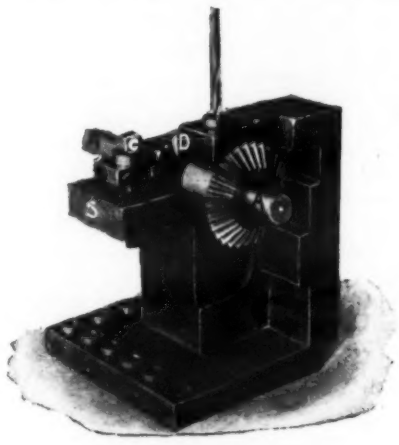


Fig. 9.

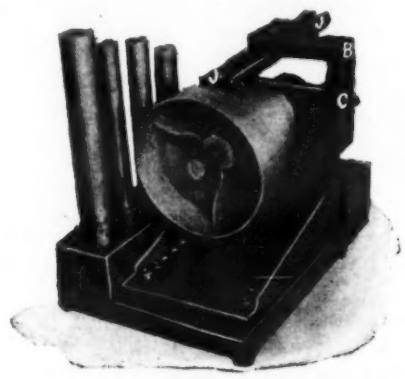


Fig. 10.

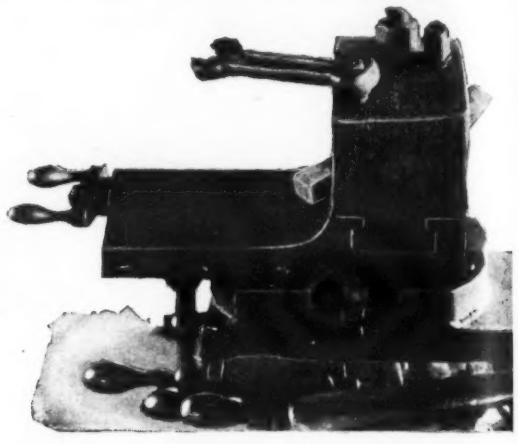
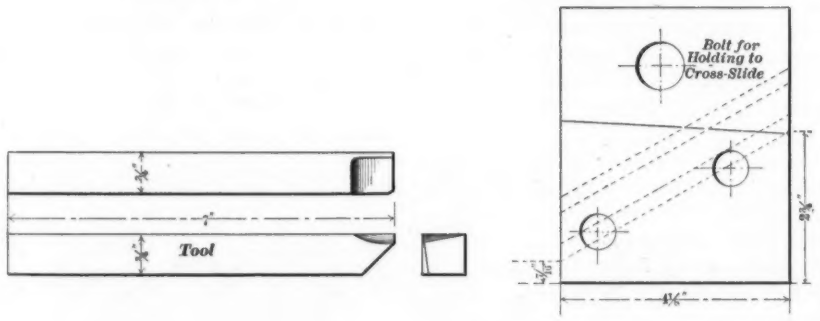


Fig. 11.



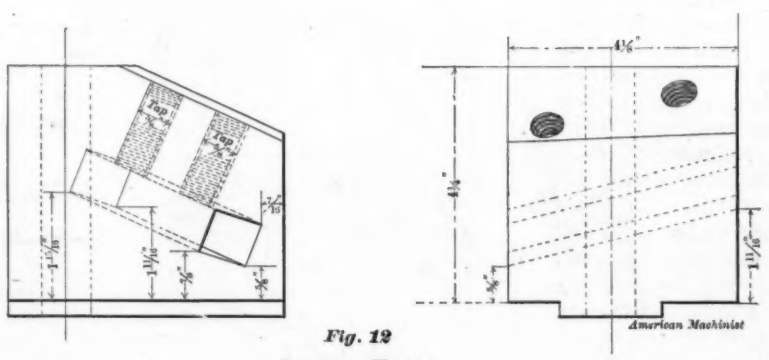


Fig. 12

SPECIAL TOOLS.

A LATHE TOOL HOLDER.

A new lathe tool holder for heavy cuts and fast work is shown in Figs. 11 and 12, which show its construction, and in Fig. 13, which shows a chip being cut by this tool, while Fig. 15 shows a chip made with the tool set a little farther out, so that the chip does not curl quite so quickly, and the piece and unsevered chip are taken out of the lathe, and photographed separately to show the very slight chip distortion induced by the use of this peculiarly seated and held lathe tool.

Two effects must be produced by a turning tool; the chips must be separated from the stock in two planes; commonly there is another and wholly needless effect produced, which consists in bending the chip and shortening it, so that a lathe chip is invariably crooked, and thicker than it was as it lay undisturbed in the stock, and very commonly is also broken nearly in two crosswise in a great many places; all of these needless effects are produced at the cost of uselessly expended lathe-driving power, and what is much more serious, at the cost of greater strains on the work, and vastly greater wearing effects on the tool itself than are needed to do the desired work. It would appear evident that the less the chip distortion and breakage, the less the useless work done, so that the straighter and thinner and more unbroken the chip turned off by a given feed per inch the more cheaply that chip is cut.

But there is another side to the lathe-tool question which deals only with the cutting tool itself viewed as an implement to be largely produced and constantly maintained in every machine shop.

The common forged diamond point is perhaps the most expensive lathe tool ever used, that is to say, the diamond point costs more per inch of cutting body to be ground away in cutting edge maintenance, than any other tool in use. To reduce this cost, straight cutting bits have been detachably secured to bit-holding stocks, many of which have been patented and put on sale, and bought and used with economical results.

The tool block here shown does two things—it makes a very cheap inserted bit lathe tool, and furnishes a very cheap and stiff tool post. In brief, this inserted bit lathe-tool holder is simply a gray iron block bolted on the tool-post slide, pierced with an oblique square hole to take a hardened bar of $\frac{3}{4}$ inch square tool steel, and tapped from above for two set screws; Fig. 11 shows the general appearance of this tool block in working position, and Fig. 12 is a reproduction of the working drawing from which it was made. The tool, or bit, is a simple straight piece of $\frac{3}{4}$-inch square tool steel, hardened the whole length. The lathe swings 19 inches. The dimensions in Fig. 12 give the obliquity of the hole in both directions, and also the twist of the tool seat which gives the front, or leading, tool-face clearance. The stock being turned in Figs. 13 and 15 is Midvale crucible spindle steel, which is by no means a very soft or easily cut material; rough diameter, $3\frac{1}{4}$ inches reduced to $2\frac{3}{8}$ inches diameter, cut $\frac{7}{16}$ inch deep on a side, feed 38 per inch. The angle of the tool makes the chips $\frac{9}{16}$ inch wide, and its thickness is from 60 to $\frac{61}{1000}$ of an inch. The chip shown in Fig. 15 has a much more open curl, hence shows less bending distortion, and is also less easily broken, showing less fracturing strain in process of cutting. This tool post and tool and work produced by their use are thus minutely illustrated, as the subject of fast lathe work and cheap lathe tool making is one of prime importance, and the full value and scope of this simple and cheap evolution of the inserted bit lathe tool, should be fully comprehended by all persons interested in the production of engine lathe work. In the case of this particular job which was always turned with specially prepared tools, this tool post turns out fully one-fourth more work than anything else ever used. Fig. 13 shows the marks on the finished surface of successive settings of the tool made in the effort to produce the long spiral chip shown in Fig. 15. Theoretically, Fig. 15 is thought to show the best chip; in practice, however, this good chip is taken care of with difficulty; it is very strong, and cannot be allowed to wander around the shop at will, and it is broken only with considerable difficulty. Fig. 13 shows the preferred form of chip, which is not nearly so strong and breaks off occasionally in such lenths as are not inconveniently carried away.

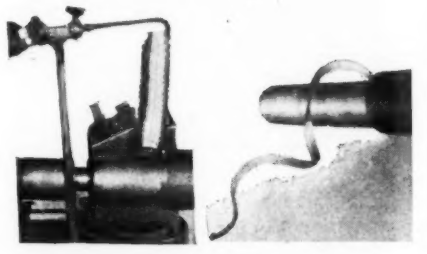


Fig. 13.

Fig. 15.

The careful and systematic attention given by Mr. Holz to all the finishing operations under his charge gives great force to his emphatic recommendation of the general use of this tool post where much stock is to be removed.

While this is being written the same lathe on same job is taking a cut 20 per inch feed, chip $\frac{9}{16}$ inch wide and $\frac{81}{1000}$ of an inch thick, flooded soap and water lubrication, 11 revolutions per minute. The soap used is the

"E. Eldred Magic Crown Drilling Soap," made at Milwaukee, Wis.

Fig. 16 shows a power-driven tail-spindle feed on this same 19-inch lathe, used in drilling the milling machine spindles; it is illustrated here to show a very simple screw and worm gear releasing arrangement, by which the tail spindle screw is made either

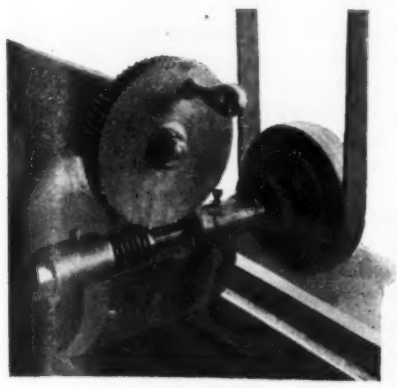


Fig. 16.

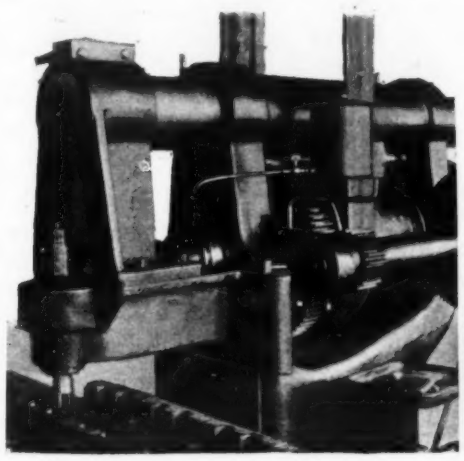


Fig. 17.

SPECIAL TOOLS.

Fig. 18.

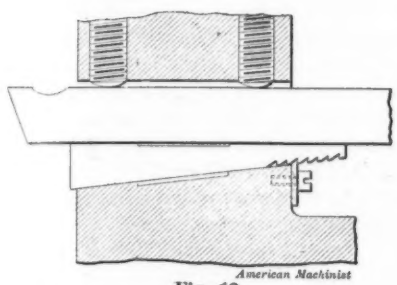


Fig. 19

machine or hand driven instantly. The worm is splined on the worm shaft and the working thrust is taken on the shoulder *T*; the drive is shown disconnected; to put the power drive in gear it is only necessary to push the worm along on the spline shaft until the worm thread engages a worm wheel tooth; a hand "racing" turn on the worm-gear handle disconnects the power drive. The extreme simplicity of this worm-drive shift makes it valuable in special cases.

VERTICAL MILLING ATTACHMENT.

Fig. 17 shows a very well supported vertical spindle end-milling rig applied to the pillar and knee milling machine. The support is had by a rigid A-frame gibbed to the pillar dovetail, and an upright extension from this base A-piece up to the overhead supporting arm. This gives a fore-and-aft and up-and-down support to the end mill, having the plane of its cutting face parallel to the plane of the table, and would seem to give all possible efficiency of support to this very useful combination; the rig is easily and quickly put on and taken off, and is also easily and cheaply made, and commends itself sufficiently without an elaborate rehearsal of its merits. It is in constant use at the Cincinnati Universal shops, and is furnished to order.

FOLLOW REST AND TOOL HOLDER.

Fig. 18 shows a self-contained follow rest and screw-threading tool post, used in this shop for threading table feed, cross, and knee screws. *A*, Fig. 18, is the tool post block proper of the lathe, slid back and used as a back support for the threading rest; the seats *B B B* and the quadrant web *W*, and the way *F*, for the sliding tool-carrying block or post *T*, are all parts of one solid casting. This gives a closeness and a rigidity of threading tool and work support not attainable by the common separate follow rest and tool post. The vertical tool adjustment is had by an adjustable wedge underneath the tool. The same simplicity and directness, and the same idea of collecting as many separate parts into one, that mark the previously described work of Mr. Holz, is very evident in this convenient and rigid screw-cutting follow rest.

It will be observed that the bearers and the tools are brought up very close to the left-hand face of this combined follow rest and tool post, so as to work short neck screws; and it is to be further noted that either the three naked bearers alone may be used to support the work, or the work support may be had by the mutilated bush, as clearly shown in Fig. 18. This choice of means of work support is quite important. The turning and the rough cut of the threading is better done with the three-jaw support only, while great precision of screw is secured by the use of the mutilated bush support in the final finishing of the screw thread.

Fig. 19 is a section of the tool post used with this follow rest; the tool elevation is readily had by the wedge support of the tool; the latch which fixes the position of the tool is screwed permanently in place; to adjust the tool hight the tool post screws are slacked off enough to allow the wedge to slide along over the top of the latch. This forms a very simple and perfectly rigid adjustable tool post, cheaply made, and entirely reliable when in use.

Russian Iron Industries.

Russia has been very slow in the development of her iron industries. With inexhaustible deposits of iron ore of the very best, and abundance of fuel, she is behind even France which is not rich in iron ores. In the last ten years Russia's pig-iron production has increased threefold, but is still trifling as compared with her wealth of opportunity. In 1894 the following was the pig-iron production of the countries named:

England	8,251,592 tons.
United States	7,457,128 "
Germany	6,301,544 "
France	2,293,112 "
Russia	1,498,648 "

Here it will be seen that England produced five and one-half times as much as Russia, the United States nearly five times as much, and Germany four times.

The United States began late, and has nearly caught up to old England, and Russia is now asking, "Why should that which is possible for America be impossible for us?" In the Urals many beds of iron are not worked, although the red hematite ores of the region deserve special attention. The ore yields 64 per cent. in smelting. Forests are in abundance, but are wasted in being burned down instead of being used for fuel for iron industries.

The duty on iron in Russia is of two kinds—a "raised" tariff, which is charged upon iron from countries with which Russia has no agreement, and the conventional tariff upon iron from countries with which she has an agreement. The "raised" tariff on iron in bars, puddling iron, iron in powder, and iron rails, is $32.91 per ton, while the conventional tariff is $21.39 per ton. The "raised" tariff on sheet iron to No. 25 Birmingham gage is $43.60 per ton, and the conventional tariff is $27.79 per ton. On sheet iron above No. 25 the "raised" tariff is $47.90 per ton, and the conventional tariff is $34.20. The Consul-General at St. Petersburg, from whose report the above information is gathered, concludes as follows:

"Russia thus far has neglected the riches which nature has given her, and acts as a people for whom iron is not an article of first necessity, but of luxury. Here, it would seem, are rich fields for enterprise and industry, and a profitable opening for capital."

American Machinery in Spain.

The sons of Tomas Haynes, Cadiz, Spain, write us as follows:

"Having been many years established in this country and had great experience commercially with this nation, permit us to point out to you one of the difficulties that we experience in introducing new classes of machinery, etc., and we have invariably found that printed information, such as is contained in illustrated catalogs, periodicals, etc., has not been sufficient to augment and increase business; what is actually required is that our manufacturers and farmers should actually see the goods, etc., and we would suggest that a number of American machine builders, etc., organize together for the purpose of having stock or show rooms in each of our provinces. Now, for instance, if several were disposed to entertain this proposal we could arrange a place for this purpose in a central part of this city for a minimum amount of rent, and we feel sure that by this means great impulse would be given to this class of business. Further, we would point out

MEMBERS OF THE A. S. M. E. AND THEIR FRIENDS AT STAR ISLAND, NEAR DETROIT, JUNE 27TH.

to you the laxity of advertising matter, such as pamphlets, etc., arriving from the United States, admitted we sometimes receive these publications, but in nothing like the extent to the number we receive from the United Kingdom. From our knowledge of Spain, a nicely got up catalog or price list printed in the Spanish language, and a depot at each of the capitals of provinces, a grand future could be worked up for all classes of American machinery and tools."

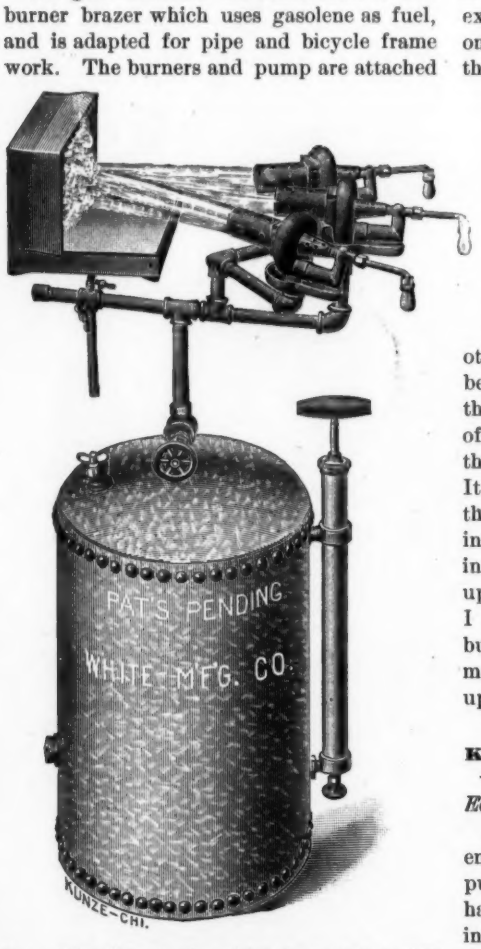
The Gun Shrinks When Heated.

Under the heading of "The New Army Gun Explained," a New York paper publishes a dispatch from Willet's Point consisting mainly of the ideas of an expert marksman concerning the new army gun, the Krag-Jorgensen. Owing to the fact that this man can surpass about everybody else in shooting at targets, it is declared that his opinion of the new gun "is therefore worth considering." The extract will serve to show how well informed the marksman is on mechanical matter connected with gun construction :

All these defects in the sight can be remedied, but there is another more serious fault which Sergeant Nihill speaks of. He says the shots vary greatly, owing to the heating of the gun, which takes place very quickly. After six shots are fired from the gun, he says, the barrel becomes so hot that a man cannot bear his hand on it. This, he says, causes the steel of the barrel to expand, which, as the tendency is inward as well as outward, reduces the size of the bore, and thus retards the speed of the bullet, causing it to lower as the gun grows hotter.

Heater for Brazing.

We give herewith an illustration of a 3-burner brazer which uses gasolene as fuel, and is adapted for pipe and bicycle frame work. The burners and pump are attached



to a 10-gallon tank, which is tested to 150 pounds pressure.

The arrangement of pump and burners is such that pressure is evenly distributed, and the flames converge at 8 inches from the burners. Quite heavy brazing can be done, the six joints in the drop hanger of a bicycle frame, for instance, being brazed in five minutes, at one heat. The back is adjustable for all sizes of work, and special holding devices can be readily attached. It is made by the White Mfg. Co., 40 State street, Chicago, Ill.

American Technical Publications Abroad.

Not the least important of our exports today are our technical publications. Only a generation ago the engineers of this country looked to Europe, and especially to England, for their supply of technical literature. "The last twenty years, however," says *Engineering*, London, "have seen an astounding development of the American engineer." We have richly endowed and splendidly equipped technical schools and an army of live professors. We have the several national societies, such as the Mechanical Engineers, the Civil Engineers, the Mining Engineers and the Electrical Engineers (we are not responsible for this order of arrangement) whose yearly published Transactions belong to the world. Our practical men as well as the more leisurely professors contribute largely to technical literature, and their work is welcomed and appreciated wherever science holds sway. International copyright will be found to be in no field more mutually helpful than in the protection and promotion of technical literature. We notice that the well-known publishing firm of W. H. Wiley & Sons have arranged with Chapman & Hall, of London for the British, European and Colonial trade in their valuable publications.

LETTERS FROM PRACTICAL MEN.

The Teeth on the Miter Gear Pattern.

Editor American Machinist:

I read with interest Mr. Dingey's article in the AMERICAN MACHINIST, August 22d, upon "Making a Miter Gear Pattern." I do not see why he limited his method to miter gears, as it is, of course, equally applicable to all bevel gears, and, in fact, in the method of attaching the teeth to the pattern, which is the principal point of the article, also to spur gears. About the method of making the teeth, it strikes me that the article is not as clear and explicit as it might be, and certainly not clear and explicit enough for its full comprehension by one of my limited capacity. I understand that the face of the pattern before the teeth are put on is turned under size, so that it does not form the bottom of the teeth, and each entire tooth, except the top of it, is shaped by hand. The face of the pattern cannot, of course, be turned very much under size or it must make the pattern weak. The alternate teeth, as I understand it, are glued on, and have to be shaped without removal, while after sawing the teeth apart every other one is taken off, and is shaped at the bench. Then these loose teeth must have a thin wing upon each side forming one-half of the bottom of the tooth space, so that they will require very delicate handling. It must also be a rather ticklish job to get these odd teeth back securely and accurately in place, and then there will be the saw kerf in the middle of each tooth space to be filled up. I am certainly glad to learn as much as I can of this different way of doing things, but after all I think that the dovetailing method has not yet been much improved upon. TECUMSEH SWIFT.

Keeping Fire Pumps Ready for Service —Temperature of Water in Boilers.

Editor American Machinist:

A few weeks ago one of your correspondents described his plan for keeping a fire pump ready for action, which consisted of having a very small hole bored through the internal part of the throttle valve just below the seat, the sole object of the same being to keep the steam pipe free from water, but while this is a good plan so far as it goes, it does not prevent the steam cylinders and pistons from rusting, nor prevent the piston-rod packing from corroding the rod and becoming dry and unfit for use at the critical moment when a fire pump is needed for prompt service.

On one of my visits to a large steam plant, I found the fire pump constantly in motion, although it moved very slowly, and on investigation I found that while this pump was controlled by an automatic governor, which was so constructed that when the water pressure was lowered from any cause, steam would be admitted and the pump started in the usual way; in addition to this a small hole had been bored through the water piston, which allowed the water to pass from one end of the water cylinder to the other, thus keeping the pump in motion constantly, although no water was pumped in the ordinary sense of the word.

The consumption of steam was small, no water was wasted, and the pump was known to be ready for instant use, night or day. Of course, when the pump is in hard service, there is a slight leak through this hole, but it is of little account, and if it becomes enlarged by the action of the water passing through it, the attention of the engineer is called to the defect by the increase in the speed of the pump under normal conditions. I do not know who should have the credit for introducing this plan, but believe that the pump was one of the well-known Worthington type. If there is any better way for keeping a fire pump in good order let some of your many correspondents describe it.

Another correspondent wants to know why it is that some of the writers for mechanical papers use the word "we" instead of the pronoun "I" when referring to themselves, as every reader knows that it is of their own work that they are speaking.

In reply, would say that it does not look well to see an article full of those important looking capitals, as it appears egotistical, hence efforts are made to avoid them as much as possible, also because it makes more of a variety, which is desirable. However, it is the practice of some editors to insert the "I" where the correspondent is too modest to use it. Several years ago the writer sent a communication to one of the monthly mechanical papers, in which the pronoun referred to scarcely occurred at all, but when printed there were about a dozen of them which were very prominent. This was bad enough, but when the next issue of the paper appeared, containing a letter from another correspondent who criticised the writer severely for using so many "Is," it seemed like adding insult to injury, but there was no redress.

While engineers usually admit that the water in a boiler has the same temperature as the steam, except in cases where there is no circulation, or where water of a lower temperature has just been pumped in, still some appear to think that if we allow all of the steam to escape, the same temperature is maintained in the water. This is a mistake, for as the steam escapes the pressure is reduced, and when only atmospheric pressure remains, the temperature is reduced to 212° Fahr. where it was 308 under 60 pounds gage pressure, and the latent heat is increased from 898 to 966 degrees, if we ignore fractions.

I should be pleased to read an expression of opinion as to why it is that when we blow our boilers off under pressure, said pressure remains practically constant as long as there is any water left in the boiler, but when it is all gone the pressure falls rapidly. If enough water is removed to double the steam space, why is the pressure not reduced one-half ?

W. H. WAKEMAN.

[The hole through the piston of the fire pump, which our correspondent speaks of, strikes us as decidedly objectionable. The result accomplished could have been secured by a run-around pipe connecting the two ends of the cylinder, then with a small cock in this pipe the re-flow could have been adjusted as desired, and shut off entirely when the full duty of the pump was required.—ED.]

"Accuracy in Gun Work."

Editor American Machinist:

I noticed your editorial comment in issue of 15th, on "Accuracy in Gun Work," that you did not consider a variation of only 5 pounds between seven built-up guns, weighing each 115,000 pounds, as anything remarkable. I would respectfully suggest that there is one cause of variation of which you take no notice, that is, variation in the specific gravity of the steel. Taking that into account, I should be inclined to regard so close an agreement as purely accidental, especially in view of the fact that, owing to the great weight of the parts, the steel must have been made at different heats at the mill. W. W.

[We did not say that we did not consider the close agreement in weight remarkable. We simply called attention to some features of the phenomenon that we thought had been overlooked. As a matter of fact, we doubt if there is at Watervliet any means of weighing 115,000 pounds within a limit of error less than 25 pounds —ED.]

The Arm Movement of Radial Drills.

Editor American Machinist:

In your editorial remarks, in your issue of July 18th, referring to the needed addition to radial drilling machines, you state that there is one feature of our drilling machines (referring to American construction) that we think is open to serious objection, that is "the manipulation of the arm."

I note that you refer to my patent radial drilling machine (although not mentioning my name), which you kindly illustrated some years ago, which machine embodied all the points at issue.

I may mention that I patented this machine close upon 20 years ago, and I have manufactured them since in large quantities. The value of machines constructed upon this principle, as illustrated by you in your issue of ——, 1889, can only be appreciated when brought into direct competition with machines lacking the features you refer to.

I trust your remarks will be the means of drawing the attention of users of radial drilling machines to the advantages embodied in my patent.

WILLIAM ASQUITH.

Highroad Well Works, Halifax, England.

Some Points About Lathes.

Editor American Machinist:

Why do our American tool builders send out such unhandy face plates with their lathes ? The slots as placed are not convenient to fasten anything, and when you try to adjust an angle plate it cannot be moved exactly up or down, as the slots have a tendency to draw the fastening bolts in the wrong direction, and you have to fuss and worry before you can get the piece of work in the right place.

Now it seems to me if the slots were placed something after the pattern of the English practice, it would facilitate work very much, and by placing four T-slots at right angles to each other the placing of holding bolts would be also facilitated and time saved.

Why do some builders of lathes with compound rests fasten the upper slide so that it cannot be removed ? If the slide could be taken off many attachments could be made to do a great variety of work.

Why do not lathe builders devise some means to hold the bolts that fasten cap over spindle boxes so they will not come loose ?

In cutting a thread on a dark day, the placing of a piece of white paper on carriage directly under the cut will enable you to tell when it is up sharp, and also prevent straining the eyes. A TINKER.

That Flexible Scale.

Editor American Machinist:

There is in use among machinists, tool makers, and draftsmen, to some extent, what is called the flexible scale, usually a narrow and thin ribbon of spring steel. One advantageous use claimed for it is that it can be used to measure around the outside of a circular or curved piece. But will this flexible scale bend around and measure correctly ? I find that it will not.

I have a disk which by micrometer gage is 1.515 inches in diameter, and by computation is 4.7595 inches in circumference. Now we cut a ribbon of fine, hard, calendered paper, and make its length to exactly encircle the disk. Its thickness is .00425 inch; we find it measures 4.7713 inches in length, which is .013 too long. Here is the problem in another form. If I were asked to give the circumference of this disk, I would cut a piece to exactly encircle it, measure its

length, and subtract from the same three times the thickness of the ribbon measure.

$1.515 \times 3.1416 = 4.7595$.

$.00425 \times 3 = .01275$.

$4.77225 - .01275 = 4.7595$.

We will take another example: We turn up a wheel, which by calipering we know is exactly 12 inches in circumference; now we take a 12-inch flexible scale, which, if it is correct in length (often 12 inch commercial scales vary from two to three one-thousandths from exact length), we find in encircling this disk that it falls short of meeting at the ends by just three times the thickness of the scale. If it is .01 of an inch thick, then the deficiency will be .03 of an inch. If .015 thick, then the deficiency will be .045 of an inch. Again, suppose we were to lay out by this bending scale (.015 thick) 9 inches in length on the exterior of a wheel whose circumference is 24 inches. Then we have the following: $24 \div 9 = \frac{8}{3}$, and $\frac{8}{3}$ of .045 inch = .017 inch deficiency in this measurement by the flexible scale. Perhaps it may occur to the reader that I have taken extreme cases, that circular measurements are seldom attempted beyond a limited section of a circle. My answer is that the principle holds good, and that no correct circular measurement, however limited, can be obtained by the bending scale, unless we do one of two things—either have a scale graduated correctly for the circle to be measured, *i. e.*, to gain in length per ratio of thickness of scale and circumference of circle, and to be used only on that same sized circle, or else to intelligently calculate the amount needed to add for deficient measurement. I am not introducing this as a new discovery, but am stating a well-known principle among mechanics—that where one piece of metal is to be bent around to encircle the other, the outside piece, of course, must always be cut a certain amount longer than the inside piece, and this added length is determined by the thickness of the same.

The man who lays out the sheets for the sections of a steam boiler knows this principle, and he also knows that previous to rolling the same, the outside sheet must be cut a certain amount longer, and that the rivet holes in the outside sheet must be spaced farther apart than those of the inside sheet, and so when the sheets are thus carefully laid out, punched, rolled, and assembled, the wider spaced holes of the outer sheet match the closer spaced holes of the inner sheet. F. W. CLOUGH.

Standards—Twelve-Thread Half-Inch Bolts.

Editor American Machinist:

In the machine shop there are many unavoidable causes of anxiety—many risks to be run, from which it cannot be free. The machine business has been made, however, far more agreeable of late years by the development of standards, which, if not in general use, exist, and so may be obtained to settle a dispute. Sooner or later these standards will be universal.

The work of arriving at a standard seems to the writer to be about the most thankless task possible, and some experience in this direction makes him willing to take off his hat to a man like Mr. Bond and to those who put up the money for such splendid work in the line of standards.

It is fair to suppose from conversations with many engineers upon this subject that about one man in five hundred has any idea what an amount of labor and money has been spent to make it simply a question of paying for a gage—to get something which is of known dimensions.

Some standards do not at all meet the views of the writer, but he believes that a bad standard adhered to by all is better than a very much superior one accepted by a few only, and when there are two standards so near alike as to make it an easy matter to take one for the other there is cause for complaint.

As a case in point, we have 12 and 13 thread taps $\frac{1}{2}$ inch diameter. Men who are constantly handling these sizes of bolts, nuts, cap and set screws, at once detect the difference, but most men will not notice a difference until a 12-thread nut has stripped the thread on a 13-thread bolt.

I believe 13 threads preferable to 12, but would gladly join a union which would put to death by slow torture anybody found with a 13-thread tap, bolt, nut or cap screw, provided it had been universally agreed upon to do away with 13 threads—or *vice versa;* this dual standard is an unnecessary source of loss to all, and the AMERICAN MACHINIST would be doing a grand work, if it would lend a hand or pen to do to death this twin horror. W. D. FORBES.

Hoboken, N. J.

Use of Cyanide on Tool Steel.

Editor American Machinist:

In your issue of August 22d your correspondent "T. H. M." asks for information in regard to the use of cyanide of potassium for steel-hardening purposes.

The light thrown on the question by Mr. P. H. Patriarche seems to me to be somewhat too limited. If this gentleman can and will tell us why the cyanide is of value for the purpose, we shall be better able to use it intelligently. My own belief is that this salt assists, because of its powerful deoxidizing properties, and also because it forms a liquid film on the surface of the steel, which causes a more perfect contact between the steel and the water, thereby permitting a more rapid abstraction of heat.

The inevitable formation of a thin coat of oxide is unfavorable to the process of rapid cooling, and as rapid cooling seems to be the one thing necessary for success as to hardness, any means used for the removal of a bad conductor of heat, like the black oxide, will be of advantage, and more especially if this means also results in the formation of a liquid film on the steel surface having the affinity for water which we all know is so peculiar to potash cyanide. I would recommend the removal of all scale or oxide from the surfaces of steel to be hardened, either by pickling or by the cyanide.

Steel covered with a very thin film of oxide will take the heat less quickly when immersed in hot lead than if the steel be bright before being immersed, this being the case it would seem to follow that, because of a film of oxide, heat will leave steel more slowly when being cooled by water.

Brooklyn, N. Y. T. R. ALMOND.

Best Method of Heating a Machine Shop.

Editor American Machinist:

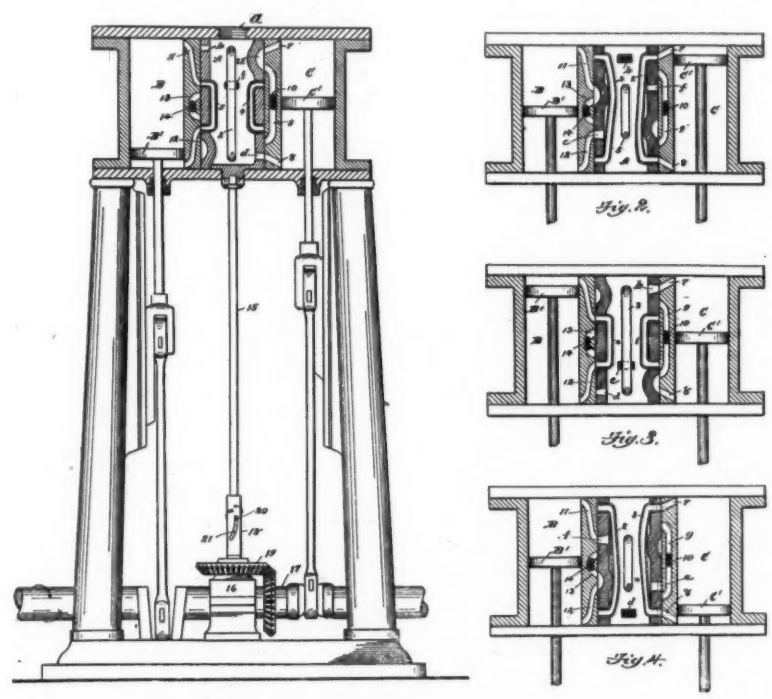
Will my brother machinists give me their ideas as to the best and cheapest way to heat a two-story machine and woodworking shop? (Barring the hot blast, which we know is best, but cannot have.) Do you recommend the wall or overhead system, and would you return drip to boiler where it can be done by natural drain of, say, 3 or 4 feet in a 60-foot building and 25 feet wide? Engine and boiler are at one end. Can make a circuit and return to boiler. Will the brothers give me their experience and advice? Will arrange to use either live or exhaust steam.

ASA P. HYDE MACHINERY AGENCY.

Oxford, N. Y.

A Novel Steam Engine—Patent Office Practice That Is Not Novel.

We take pleasure in laying before our readers the Patent Office drawings and some description of a novel steam engine, the patent for which has recently been issued. In this engine "the special feature of improvement consists in the provision which is made, whereby the steam which has been employed to actuate the piston, driving it in one direction, is in part transmitted to the opposite end of the same piston which it has been driving, and acts to drive the piston in the opposite direction," and the design of the engine proceeds to apply this "principle." The engine consists of two similar vertical cylinders, with pistons connected to cranks at right angles. The steam cylinders are independent of each other. One revolving cylindrical valve performs the entire steam distributing function for the two cylinders. The four successive sections of the cylinders show the positions of the parts at successive quarters of the revolution of the crank shaft. The steam is admitted to the interior of the valve through the upper opening in the chest. Confining our attention to the left-hand cylinder, it will be seen in Fig. 1 that the lower end of the cylinder is in direct communication with the upper end, and receiving steam from it according to the "theory" of the "invention." This operation goes on for a period not clearly indicated, but presumably for a little over three eighths of the upward stroke. At the middle of the stroke, Fig. 2, the lower end of the cylinder is in full communication with the steam supply. "Live steam is let in behind each piston at the period of time when its own crank is about at right angles to the line of motion of its piston rod. The steam is used most effectively for the action of the crank shaft." The entire steam admission occupies about one-sixteenth of the stroke, and the exhaust from the other side of the piston occurs at the same time with the admission. The steam just admitted operates expansively then for perhaps one-quarter of the stroke, while compression goes on in the other end of the cylinder, but before the end of the stroke is reached these operations have ceased, and the two ends of the cylinder are put in communication with each other for accomplishing the supreme purpose of the whole invention—that of using a part of the steam over again in the other end of the cylinder. We trust that our readers will be able to understand the operation without further description, and we feel confident that they will unite with us in admiring the ingenuity displayed in its design, and in wondering why a patent should have been granted for an engine which violates nearly, if not quite all, of the laws of steam engineering. Is there not something wrong in the system, or in the rules of practice that can make the issue of such a patent possible?



A NOVEL STEAM ENGINE.

We believe that the patent laws of the United States have done much for the promotion of mechanical invention, and for the advancement of national prosperity. We believe that these laws are still doing and are still to do much for the general welfare. We think that they might do much more good than they are now doing, and one improvement would be in the refusal of protection to absolutely worthless inventions. The work of the examiners in the Patent Office is done with reasonable thoroughness, so far as the looking up of prior inventions and interferences is concerned, but the fact that nothing has ever before been made or done like it, should not be, as now seems to be the case, the only condition essential to the allowance of a patent. An applicant for a patent alleges that he has invented a certain "new and useful" improvement. The work of the Patent Office seems to be confined entirely to ascertaining whether the alleged invention is new or not, which is a matter of little importance to the general public, who are supposed in the end to be benefited by the patent. The important question really is whether an invention is useful, yet every week patents issue which the examiners, if they are otherwise qualified for their duties, must know to be practically worse than worthless, and against the most thoroughly established principles. The worst of the matter is not that visionary inventors find encouragement and are led to waste time and money for naught, that unscrupulous patent attorneys fatten upon them, and that credulous capitalists are fleeced with the promise of rich returns, but that so many of these patents upon things that could not possibly work, still embody some element essential to some other invention coming after with every reasonable promise of success, but hopelessly barred by the priority in the thing that is worthless. Besides proving novelty, an inventor should be compelled to establish a reasonable presumption of usefulness before a patent should issue.

Literary Notes.

ENGINEERING CONTRACTS AND SPECIFICATIONS. By Prof. J. B. Johnson, C. E.

In this book the author has undertaken to furnish to engineers and others a means of knowing just how a contract for engineering work should be drawn, how it should be interpreted, and how it will probably be construed by the courts in case a question arises that must be settled by them. It is not intended for lawyers, and in all very important cases the author recommends that a competent lawyer be consulted. There is, however, a synopsis of the law of contracts, and the forms used by a number of the best known engineers have been used in making the reader acquainted with the principles underlying engineering contracts, and with the legal complications and pitfalls into which the uninitiated may fall. The work is divided into four parts. Part I. gives a synopsis of the law of contracts. Part II. treats of engineering specifications and accompanying documents. Part III. specific description, or technical clauses in specifications, and Part IV. illustrative examples of complete contracts and specifications. Each of these divisions is subdivided, and systematically treated in such a manner as to make the book very useful to an engineer or manufacturer who has anything to do with contracts for engineering constructions. There are 417 pages 6 x9", bound in cloth. It is published by the Engineering News Publishing Co., New York. Price $4.

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The Cultivation of the Customer.

The publication and general dissemination by our government of the reports of the consuls in the various countries with which we have intercourse is a national service of the highest value. Much interesting, reliable and practical information that would not be otherwise attainable is thus brought before us, and much benefit and profit must be eventually realized therefrom. Our consuls seem to be especially instructed to look out for the weak places or the gaps in our neighbors' fences, where we may be able to break them down or to slip through them, and our trade may thereby fatten and grow. But it often happens that it is not a matter of fences at all. If the fences were all removed and we were free to flock in, there might still be no pasture for us. Russia is one of the countries to which we look as a possible market for some of our surplus products, and the chances of finding anything to encourage us there may be gathered from the few facts in the report from which we have quoted. Russia, with more than double the area of the United States and nearly double the population, makes about one-fifth as much iron as we make. Here surely, as the consul suggests, "are rich fields for enterprise and industry and a profitable opening for capital" to engage in the manufacture of iron. But the preceding sentence in the consul's report completely knocks over this conclusion in advance. It is said that Russia "acts as a people for whom iron is not an article of first necessity, but of luxury." With the vast military and naval equipment to provide for, and the consumption for great public works deducted, the iron consumption per capita is not more than one-tenth that of the United States, and it is here, in the consumption and not in the production, that the explanation is to be found. More iron is not produced because it is not wanted. This is shown by the steadiness and the slowness of the increase. In 1890, the pig-iron production was 1,021,244 tons; in 1891, 1,107,550 tons; in 1892, 1,134,170 tons; in 1893, 1,248,970 tons, and in 1894, 1,498,648 tons. It is pretty evident that the people got all they wanted. The prospect of profit in proceeding to manufacture in largely increased quantities for such a people must be a very discouraging one. This consular report, at the opening of it, puts the situation very clearly: "The iron industry is one of the most important elements of the industrial progress of a country. We have countries on the one hand which have advanced in culture and learned the value of industrial development, although nature did not bless them with extensive riches of iron ore. These countries are exploring the earth from one end to the other of their territory for iron deposits, and, when found, they know their value and put every bit of them into use. On the other hand, we have countries that have an abundance of iron ore deposits, but do not pay much attention to them and are dilatory in their development."

So, then, it is not the ore in the earth so much as it is the wants of men that build up the iron industry, and every other industry with it. The iron manufacture is an unerring index of the nation's status. Its activity and growth means national prosperity, and progress in civilization. Why not reverse the operation in our thought? Civilization means a larger life and daily growing needs, and iron is in touch with every need of man. It is not so true that the production and manufacture of iron elevates man as that the elevation of man demands more iron and more varied products of iron for his use and enjoyment.

We look at civilization too far off. Civilization is only national respectability, and personal respectability is only civilization in detail. Respectability, or worthiness of respect, or worth, is worth to self first of all, and after that to the immediate community, to the State and to the nation. The differences in nations are not more marked than are the differences in men. One nation is more civilized than another; so is one man more respectable than another. One nation uses more iron and more of every product than another, and so do men vary in their uses of the products of industry. It is the instinct of trade to cultivate customers wherever they may be found. They may be found in foreign lands, and none would be more ready than we to welcome them, but they are still to be sought and cultivated at home. The diffusion of products carries with it a diffusion also of methods and habits, an equalization, and, in the long average, an elevation of all. The ultimate problem for all men is to develop the consumption and enjoyment of man's good handiwork at a pace commensurate with the growth of production.

"No Skill Required."

Looking over a machine builder's circular, the other day, we noticed the words printed in bold type, "*Skilled labor is not required to run this machine.*" The machine in question was a grinder, and anyone at all familiar with machine shop processes would know that the kind of labor required to operate it would depend entirely upon the kind of work to be done; the degree of skill necessary in the operator depending much more upon the nature of the work than upon the machine—which, in fact, is usually the case.

If a manufacturer of paint brushes should advertise that skilled labor was not required to operate them we should consider him ridiculous; for everybody knows that the degree of skill required to operate a paint brush depends upon whether you are going to paint a chicken coop, a sign, a fresco, or a portrait.

Exactly the same principles apply to machine tools that apply to such simpler tools as chisels and files; if you are going to clean castings with them no skill worth speaking of is required, but if you are to do fine vise work and fitting it is different; not only is skill then required but the higher the degree of skill the more economically the work will be done.

If sewing machine shafts or needle bars are to be finished by grinding, any intelligent boy can be soon taught to grind them satisfactorily. That does not fit him for doing promiscuous grinding on tool work, nor prove that the machine requires no skill to operate it.

There are too many shop managers who, seeing boys operating milling machines on manufacturing operations, conclude from that that running a milling machine is a boy's job, and they therefore put a boy on the tool-room universal where the work is constantly changing and where entirely new jobs are, or at least should be, coming to the machine nearly every day. In the one case running a milling machine is a boy's job, in the other a first-class, highly skilled mechanic will make the machine most profitable. The degree of skill required for almost any operation depends more upon the nature of the job to be done than upon the tools with which it is to be done, bearing in mind that constant repetition of machine shop processes usually changes their character.

The Brake on the Trolley Car.

Confirmations of our assertions concerning the causes of trolley car fatalities are constantly occurring—confirmations of a character that we are far from desiring. A little child was killed in Brooklyn last week by the fender of a trolley car. The fenders kill oftener than they save. The cars with the fewest fatalities have no fenders, but they have quick-acting brakes. It is needless to say that they are not trolley cars. It is reasonably certain that the life of the little child referred to above would not have been sacrificed if the car had been without a fender, or, especially if it had been equipped with an efficient brake, but the motor gearing might have suffered, and so an instantaneous brake cannot be permitted on a trolley car. And yet, in the face of this, among the legion of journals whose name is electrical where is the one that dares to tell the truth, the whole truth and nothing but the truth about the brake on the trolley car?

It is claimed on behalf of the motorman whose car—or rather, car fender—killed the little girl, that he was drowsy at the time from overwork. He says he was on his car all day Thursday and until 1 A. M. Friday; that he did not reach home until 2 A. M., and had to report again for work at 3 A. M. He says he told the night man in charge that he was unfit for work, and asked to be relieved, but his request was refused. If this is true, it seems to us the motorman is blameless, and someone else should be severely punished. The assumption that men can defy the laws of nature in regard to sleep, and yet be sufficiently alert to be trusted to run a trolley car in the crowded streets of a city, is outrageous.

It is our duty to record that, on August 26, 1895, Niagara—majestic, stupendous, unique—began in a small way and for small pay to work by the day under the agency of the Cataract Construction Company, furnishing the motive power for the Pittsburg Reduction Company, at Niagara Falls. The work of preparation has been in progress five years, and $3,000,000 have been expended. It is, of course, far too early to estimate the practical results of the scheme. Too many other estimates are still in progress. The amount of water used is estimated, the power developed by the water wheels is estimated, the losses of power in the wheel and generator are estimated, and also the power furnished by the generator. The loss in the line is estimated and also the loss in the transformers, and the ultimate effect realized, are all matters of estimate. The dividends to the Construction Company must be estimated for some time to come. This is in no way meant to belittle the great work that has been accomplished, but is the simple statement of the case as it stands. As fast as the solid information crystallizes we will be glad to handle it.

It is not as generally understood as it should be, perhaps, that bicycle wheels seldom or never are subjected to lateral strains. They need to resist only those strains which pass through their own plane, and in this plane only have they any strength worth speaking of. This is worth remembering when the use of wheels of this type is being considered for three or four-wheeled vehicles where the conditions are essentially different and where, in turning corners rapidly, or in going over ground that causes the vehicle to be inclined sideways, a very considerable lateral strain may be brought upon the wheels—a strain which the ordinary bicycle wheel is, very properly, entirely unfitted for. This is to be considered also in connection with devices for attaching two bicycles side by side to make a duplex or four-wheeled machine of them. Neither the frame, the bearings, nor the wheels of a properly constructed bicycle are adapted to such use without injury.

The First Horseless Wagon in New York.

The first horseless road vehicle imported into this country was exhibited on Washington square, in this city, on August 29th, it having been landed from the French steamer "La Champagne," the day previous. The vehicle is, we understand, to be used as a delivery wagon by a prominent dry goods house. At this writing we can only speak of the wagon from the standpoint of a spectator. It is propelled by one of the already numerous oil or gasolene motors. It started without hesitation and proved to be more completely under control both as to speed and direction than any horse and wagon. The engine runs constantly and the exhaust is quite noticeable. The motion is communicated by a friction device. The front axle is fixed and its wheels are turned independently by short bell crank levers. Quite a weight of water seemed to be carried for cooling purposes. No smell was noticeable. The exhibition seemed to be a decided suc-

cess, and we can scarcely doubt that such vehicles will be familiar enough in the near future.

Expression of the American Society of Mechanical Engineers on the Death of President Davis.

The American Society of Mechanical Engineers desires, through its Council, to spread upon the records of the Society and of its Council a Minute expressive of the respect and regard which its members feel and seek to make public upon the sudden and untimely death from an accident of their colleague, Mr. E. F. C. Davis, President of the Society.

The formal mold of memorial resolutions in which a corporate body ordinarily records its action seems inadequate for a proper voicing of the spirit which pervades the Council in the presence of the death of one whom its members had known so well, and whom they had learned to admire and love. His wise and mature judgment, his business and professional knowledge, his conservative yet energetic counsel, and his courteous consideration for others, had made him one from whose administration of the Society's affairs the highest hopes had been entertained.

Although with such grief the stranger intermeddleth not, yet the Council would presume to express their heartfelt sympathy with those nearest and dearest to Mr. Davis, upon whom this blow has so crushingly fallen.

Resolved.—That copies of this Minute be furnished to the engineering journals, with a request that they give a publicity to it in such a way that it may serve to convey to the profession something of the sorrow and regret with which the American Society of Mechanical Engineers has heard of their loss in the death of their president.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(333) F. A., Mansfield, Mass., asks: What makes the strain on the side of a boiler greater than on the end? *A.*—Every square inch of the interior surface of a boiler is subject to the same pressure, except that the parts below the top of the water have a little additional pressure from its weight. 2. How much strain is there on a brace? *A.*—It depends upon the size and style of the boiler, the number of braces, their position, the boiler pressure, and other conditions. 3. How far apart should stay bolts be placed? *A.*—This depends upon conditions similar to those cited in the preceding answer. None of the above questions can be answered except with reference to specific conditions.

(334) E. B., Toronto, Canada, writes: I am greatly obliged to you for the information about rust joints and will abandon the idea of using it with the old boiler tubes. How would you advise me to heat a flat, 170 x50x12 feet, with exhaust steam from a 150 horse power engine? This is a sash and door factory and we wish to heat the second story. We have down stairs a Boston heater driving hot air through 4,000 feet of 1-inch pipe, but this does not condense one-half of the steam, and we wish to use the rest to the best advantage, using pipes to convey the steam around in some way. What do you think of overhead pipes in a flat? We have no overhead shafting in the way. *A.*—Overhead pipes are quite frequently used, and, all things considered, are probably best, and we would use them in this case. We would start at one end of the room with a horizontal header up pretty close to the ceiling and, say, 3 or 4 feet from the wall and run, say, six 1¼-inch pipes lengthwise of the room, then across the end, down the other side and back to the starting point, with a pitch to the pipe all the way, so that the last header would be 2 feet lower than the first one. The first header should be braced horizontally so that it would not move, and the supports for the rest of the pipe should allow for expansion. The outlet pipe for water at the end should be of good size with a valve to choke it off if necessary, and provision should be made for admitting live steam to the whole coil for heating it up, as otherwise there would be trouble from freezing up before the exhaust could get around. This coil would take about 2,000 feet of pipe. We do not know anything about the engine, but we do not think this would use all the steam, while it probably would afford sufficient heat.

(335) A. J., Oneida, asks: Can you tell me how the mandrel is made for winding the wire handles that are now used on stove lifters, tea kettles and such things? How is the mandrel got out or how is the coiled wire got off the mandrel? *A.*—No mandrel is used for this purpose. The wire handles with the swell in the middle, the quick taper at one end and the longer taper at the other, are rolled out continuously from the coil of wire and are cut off at the proper intervals that apportion the complete shape to each. A little doctoring of the mutilated end is all that is required to complete the job. The coil of wire is mounted upon a reel, and the first end of it is led through a straightening apparatus, and it then passes between three or four or more pairs of rollers all gripping it tightly and all helping to push it along for the bending or coiling operation which requires considerable power. As the wire emerges from the last pair of rollers the side of it comes in contact with the periphery of a wheel or cam of peculiar shape which causes the wire to curve as it emerges and assume the shape desired. This shaping wheel is free to move upon its own axis, and one revolution of the wheel is coincident with the production of the complete handle. The principle of operation is perfectly simple. As the wire comes out from the driving rolls a true, circular, freely revolving wheel, placed in the same plane as the driving rollers, but so that its periphery overlapped the path of the emerging wire, would bend the wire to the side and it would form a circular ring. This operation could not be continued because the end of the wire would soon come in contact with the emerging wire; but if this wheel, still perfectly circular, were pitched so that while it bent the wire around it would also pitch it forward, the wire would then form a helical or "spiral" spring, and springs of any length or pitch or diameter may be quickly made in this way. Now if the wheel thus adjusted instead of being perfectly circular should vary from the true circle so that the radius at one point was greater or less than at a preceding point that would change the diameter of the spring that was being coiled. Where the radius of the wheel grew less it would crowd the wire less and the diameter of the coil would be larger; where the radius grew greater the wheel would crowd the wire more and then it would coil smaller. This wheel, it will be seen, can only be satisfactorily made and adjusted by experiment, and often by tedious and protracted experiment; yet there are plenty of men in these days who would not hesitate to ask for a formula for it.

(336) J. W., Pittsburg, Pa., writes: Please inform me of the process and composition of the rubber used by dentists in the manufacture of artificial teeth. *A.*—We referred this question to Mr. John T. Usher, of this city, and he has kindly given us the following information: "The formulæ for the rubbers generally used for artificial dentures are as follows:

Red Rubber.

Caoutchouc (rubber gum)	48 parts.
Sulphur	24 "
Vermillion (red precipitate or oxide of mercury)	36 "
Total	108 parts.

Black Rubber.

Caoutchouc	48 parts.
Sulphur	24 "
Calcined bone or lampblack	36 "
Total	108 parts.

Pink Rubber.

Caoutchouc	48 parts.
Sulphur	24 "
Zinc oxide	30 "
Vermillion	10 "
Total	112 parts.

The above rubbers are what are termed the fifty-five minute rubbers, which means that they are to be vulcanized for fifty-five minutes at a temperature of 320° Fahr. There are, however, a great variety of other formulæ by which dental rubbers are compounded, the proportions of which are dependent, 1st. On the temperature and time at and in which the rubber has to be vulcanized. 2d. The color the vulcanized product is to be. 3d. The quality and price of the unvulcanized rubber. In all dental rubber the vulcanizing agent employed is sulphur, and the proportions for the fifty-five minute rubbers, are two parts caoutchouc (koo-chook) to one part sulphur, the other ingredients being added for the purpose of coloring and adulterating. For the quicker vulcanizing rubbers a larger proportion of sulphur is added to the caoutchouc, and for the slower vulcanizing rubbers a less proportion of sulphur, which latter also applies to the soft rubbers, such as employed in making 'soft centers' in artificial dentures for soft palates. Further information pertaining to this subject will be found in the answer given in the AMERICAN MACHINIST, December 21, 1893, to Question No. 618."

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 719.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Marine Iron Works, Chicago (new catalog).

Patent Solicitor. J. G. D. Mack, Madison, Wis.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Wanted—Machinery to build: special, steam, mill, hydraulic. F.C. & A. E. Rowland, New Haven, Conn.

I advertise for castings to make, not fancy prices. Twining Campbell, Brass and Aluminum Founder and Mfr. of Mach'y Name Plates, Paterson, N. J.

Hand Book of Calculations (10th Ed.) for Engineers and Machinists, by Hawkins. Price $2.50, catalog free. Theo. Audel & Co., 91 Liberty St., N. Y.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Crank Shaft Stresses on the Central Valve Engine.

BY W. H. BOOTH.

Those of us who are not builders of steam engines are being not a little amused by the trade jealousies and bitterness which exist between two sections of engineers on this side the water. You do not seem to have anything on your side with which to compare the state of affairs that has so long held here. It reminds one somewhat of Swift's description of the little war that arose out of the two parties in Lilliputia over the question of cracking eggs at the broad or the narrow end. Had that country been England we should have compromised by cracking them on the side, for it is our little habit, is this compromising and is, I see, often set down to the practical common sense of the nation, though, I think, in our anxiety to compromise we often give away twice as much as the original claim; in one case, however, where we appear to have given away more than the recipients can find claimants for, we have had the money's worth in amusement over the endeavors to get rid of the award. But this is not what I set out to say.

The engine question here has resolved itself into a sort of duel between the upholders of single-acting and of double-acting engines for electrical purposes. For some years a single-acting high speed engine, favored by a particular set of men and by a most excellent system of construction, has sold in large numbers, and, like all successes, has caused its proprietors to wax and grow fat and to gradually build up a sort of theory that if you were an electrical engineer you could not show your incompetence better than by refusing to use this single-acting engine, and, of course, this sort of thing has had some effect upon younger men whose experience has been insufficient to enable them to separate wheat from chaff. Finally, however, the double-acting worm has turned, if I may use so mixed a metaphor, and the two cliques now say ugly things to one another at the meetings of the engineering societies as plainly as they dare, much as did the members of the society upon the Stanislau who talked of family vaults when the bones of a mule were before them. These jealousies need not concern us who thirst for knowledge rather than lucre, but we may be interested in the points raised *pro* and *con* each type. On the part of the single-acting engine it is claimed that on account of the stresses being always in one direction, all the moving parts being in thrust, the speed can be very high and no knock can occur, and to prevent any knock, such as would occur under low steam pressure, there is added, below the low-pressure piston, an additional cylinder containing an air piston which compresses air during the up stroke, and so brings the piston to rest on the top dead center, or rather, secures always that there shall be a down pressure on the crank pin. Of course the power absorbed by this air compression is very great, but, except when the air pump has become worn, so as to leak air, this is not a source of loss, for, on the down stroke, the power is given out again, and the loss is simply that due to extra crank-pin friction and the friction of the air piston, unless there be water present in the air cylinder, when there is considerable loss.

These high-speed engines are oiled by being run in a closed chamber containing oil and water into which the crank dips. The curious part of the principal single-acting engine is its valve system, which consists of a series of piston valves strung on a long rod and working inside a long hollow trunk. This trunk forms the piston rod and is pierced with port holes which admit and release the steam to and from the cylinders. The action is thus: Steam admitted to top of top cylinder and exhausted to underside of same. It then again enters the hollow piston rod and so enters the top of second cylinder, again escaping through the rod to the underside of this cylinder and finally to the third cylinder in the same way. This central valve is worked by an eccentric upon the middle of the crank pin, the connecting rod being double.

The valves have therefore the full travel of the pistons modified by the motion of the eccentric on the crank pin so that the valves have merely the ordinary eccentric motion relative to the hollow piston rod in which they work.

In a triple-expansion engine there are thus three steam pistons, one air piston compressing air to 80 pounds, and three sets of piston valves, as well as three sets of glands through which the trunk rod works between the cylinders. Regulation is by throttle. As a machine, therefore, the principle of constant thrust is secured, except for the line of valves at low pressures, when there is apt to be knock if the steam pressure on the top valve is insufficient to check the line of valves on the up stroke. So much for the single-acting engine for the present. In the double-acting engine for long runs at high speeds it is obvious that ordinary construction will not suffice, and advocates of single acting deny that the double-acting principle can be made to act at all for high speeds. But the double-acting men have argued that the whole question is one of proportion and design, and that thorough and effective lubrication is perfectly well attained in a double-acting engine by giving to the bearings a sufficient area, and forcing the oil to them by means of a small oil pump, which compels thorough lubrication, whilst the very principle of double acting insures that both brasses at any point, as the two ends of the connecting rod, as well as the crank-shaft bearings, shall alternately take pressure and be relieved of it, and thereby the very action itself promotes lubrication, while the length of the bearing prevents it being forced out. Necessarily the bearings must have a minimum of play, and it is right here comes in the difference to be made between a high and a low-speed engine. The crank pins and shaft must be truly circular, not merely approximately so, and they must fit their brasses properly. Now a little study will show anyone that the "stress in one direction" theory is not by any means universal in the single-acting engine. The one direction extends only to the rods. In the crank shaft it is reversed, and one writer has stated that taking two engines at equal speeds and power, but one single and the other double-acting, the stress in the single-acting crank is several times what it is in the other, if Wöhler's law of reversed stresses be taken account of, and on going into the matter I find that this may actually be true. In the first place the single-acting engine must have twice the

pressure on the crank pin, because it only acts twice in a revolution; in the second place the double-acting engine has a stress, always in one direction in its crank, if not in the other moving parts, and this stress varies from 0 to a maximum, whereas in the single-acting engine the stress already double in amount is added to on the down stroke by the air compressor which resists the up stroke. Before going into figures, suppose roughly this air cylinder adds 15 per cent. to the down stroke, then, compared with the double-acting stress of 0 to 1, we have downwards $1 \times 2 \times 1.15 = 2.3$, and on the up stroke, still acting downwards, we have a stress of $2 \times 0.15 = 0.3$. The resultant stress is thus from a minimum of -0.3 to a maximum of $+2.3$, or a difference of 2.6. Roughly, a stress varying from a minus to a plus value is supposed to be more destructive than one varying from nothing to a plus value. If such be the case the difference 2 6 just found should be multiplied by, say, $1\frac{1}{4}$, and the relative effective stresses in the two shafts would, other things being equal, as span between bearings, be as 2.925 to 1, and as shafts vary in strength as the cubes of their respective diameters, it would appear that the shaft of the single-acting engine should be about 1.4 times as big as that of an equal powered, double-acting engine at like speed, for $\sqrt[3]{2.92} = 1.43$ and $\sqrt[3]{1} = 1$. Even if we reduce the speed of the double-acting engine to two-thirds that of the other, the stress ratio is still as 1 : 2, and the diameter ratio 1 to $1\frac{1}{4}$. The subject is interesting enough to be worth working out more accurately. We will take the case of a single-acting engine with cylinders of $34\frac{1}{2}$ inches, $71\frac{1}{2}$ inches, and $141\frac{1}{2}$ inches area, and 6 inches stroke, and an air cylinder of about 100 inches area, always acting against the crank.

The underside area of the pistons which act as pumps forcing the steam forward to the subsequent cylinders, are $31\frac{1}{2}$ and 66, approximately, and from the published diagrams of a triple engine I find that the down stroke net pressure at mid stroke is 11,416 pounds, and on the up stroke is 3,259 pounds. For a double-acting engine the figures would appear to indicate about half this, or, say, 4,200 pounds on each stroke.

As the difference of pressures in the single-acting engine is a little over eight thousand pounds, I have taken fully half this for a triple-tandem double-acting engine, or 4,200 pounds, each stroke, acting upon the crank at full leverage and where the inertia action of the moving parts is practically *nil*, there being no retardation or acceleration at mid stroke. The single-acting pressures are thus 11,400 pounds, producing one kind of stress, and 3,260 pounds, producing the opposite stress, or $+11,400 - 3,260$, a total range of 14.660, whilst the double-acting pressure of 4,200 acts in the same direction on the crank at every stroke. The range of stress in the crank is thus $+4,200 - 0$, or $\frac{2}{7}$ the range in the single engine. As a pure matter of static stresses, one crank should be $\frac{11,400}{4,200}$, or nearly three times as strong as the other, or fully $1\frac{1}{2}$ times its diameter. But we are not dealing with static stresses. If we accept Wöhler's law of stresses and take Launhardt's formula for such cases, we find that where the strength of steel is 46.6 for static loads it is only 22.28 for a load applied and removed as in the double-acting engine, and only 19.5 where the stress varies, as in the case of the single-acting engine here noted, from $-3,260$ to $+11,400$. If, therefore, we multiply the ratio of stresses which is $\frac{11.400}{4,200}$ by $\frac{22.28}{19.5}$ we shall get a figure which really represents the relative stresses in the two cranks. This figure is 3.1 which is very close to the stress ratio arrived at by the rough approximation above.

Now the cube root of 3.1 is nearly 1.5, so that it appears that for tandem triple-engines of equal power the diameters of the shafts, when the engines are single-acting, must be $1\frac{1}{2}$ times that of the double-acting engine. My experience and the conclusions that the reading of experiments has forced on me is that the law of Wöhler is sound and should be acted on in all structural work, and the failures of single-acting engine crank shafts are not to be wondered at. There is so serious a difference between a 3-inch and a $4\frac{1}{4}$-inch shaft in appearance that the engine designer may well be pardoned if he looks doubtfully on a rule that tells him they are only equally strong when for static loads or equal stresses one is threefold the strength of the other. The recent controversy has again awakened my interest in the subject, shaft strengths, seeing that one shaft was stated to be *several* times as strong as the other, but I was hardly prepared to find that *several* meant quite *threefold* until I began to write this, and found that the closest figures I could get from actual diagrams of the single engine showed this to be so. In the absence of definite information as to the size and pressure in the air cylinder when at or near mid stroke my figures may be somewhat incorrect, but not so far as to seriously invalidate the result arrived at or to throw doubt on the lesson that a consideration of Wöhler's law of stress as applied to crank shafts should teach.

If now we turn to the stresses in the piston and connecting rods, we find that for the single-acting engine the range of stress is from $+11,400$ to $+3,260$, and the range in the double engine from $+4,200$ to $-4,200$. The permissible stress ratio is in the first case 29.23, and in the second 13.02, or practically as $2\frac{1}{4}$ to 1 in favor of the single-acting engine, but multiplying by the ratio of the actual maximum stresses, or $\frac{11,400}{4,200}$, we get the true ratio of proportion as $\frac{741}{613}$, which means that the double-acting engine must have its rods, for an equal power, nearly as strong as single-acting rods. Practically then, as regards strength of parts, the single-acting engine does not gain any advantage in any one item, and it is reduced to the one mechanical advantage of quiet running. In this respect you may sometimes stand close up to a single-acting engine running at full power, and require to look twice to ascertain that it is really running. Thus a single-acting engine needs no taking up of wear. If a double-acting engine wears, it must necessarily be in danger of knocking, though in this respect it is likely that single-acting advocates have laid far too much stress on the danger, and have quite ignored the possibilities of careful valve setting in effecting the reversal of crank-pin bearing pressures, so as to secure noiseless reversal. It is obvious that the pressure per square inch of surface must be insufficient to force the bearings into metallic contact. The pumping in of oil insures that there shall always be a layer of oil filling the whole space in the bearing.

So far, there have only been touched upon the torsion stresses in a crank, for all the figures are based upon a measurement of the diagrams at their middle length, where no other stresses come in. Where the duty devolves upon the crank of starting all the moving parts in motion on the up stroke against the pressure in the air cylinder, which, however, is *nil* at the commencement of the stroke, it is probable that the crank stress will be very much in excess of the minimum amount found above, for this minimum will act to bend the body of the shaft in conjunction with the inertia stresses. It would take some time to figure out these bending stresses, but the probability is that the shaft of a high-speed single-acting engine is weaker against bending than against torsion. I cannot figure it out, as I have not the weights of the parts. In this respect the double-action engine stands at a great advantage. Its steam pressure is much reduced at both ends of the stroke by the inertia of the moving parts, whereas in the single-acting engine the stress at the lower dead point is very great, the pistons being all of double area for a given power. It may be therefore that a complete investigation of the single-acting engine would demonstrate, if we suppose Wöhler's law to be sound, that the crank shaft should be somewhere between $1\frac{1}{2}$ and 2 times the diameter of double-acting shafts of same horse-power and same spacing of bearings. That such an apparently liberal allowance has not been made, may possibly, indeed probably, account for the numerous failures of single-acting crank shafts. So many have failed, and engines apparently well built have gone to ruin entirely from shaft troubles, and I venture to predict will continue to do so as long as the proportioning of shafts is made so much a matter of calculation, based upon the brake horse-power, without an intelligent appreciation of the internal stresses, of which brake horse-power is but the net balance. That bending is often more serious than mere torsion, is demonstrated by numerous failures, by bending not merely of the shafts of any existing type of engine, but of engines which have disappeared altogether because of neglect of this vital point. Single-acting engines have had their shafts strengthened from time to time, but by too small an amount. Their designers seem to lack the power to grasp the necessity of a really large addition of diameter, even though this one weakness is known and feared. It may always be taken as a fact, when the parts of a well-made machine fail time after time, that they do so entirely because of weakness, and it is exceedingly bad policy to go on trying to make the same strengths serve. But it is rather strange, nearly forty years after Fairbairn had arrived at the knowledge of the danger of reversed stresses, or rather had shown their true action, that the subject should still require the costly school of experience to re-demonstrate it.

London.

Facts for Young Engineers—IV.

By W. H. Wakeman.

BOILER FEED.

An injector may take more steam to run it than a steam pump calls for, and where the water is delivered to the pump under pressure from the street mains this is always the case, but if all of the exhaust steam from the engine can be used to a good advantage, it may be just as economical to use the injector, for it delivers the water to the heater with the chill taken out of it even in the coldest weather, so that the exhaust steam increases the heating effect to a much greater degree than when the pump is used. This fact should be taken into consideration when calculating on the most economical boiler feeder to use. Probably a good power pump, by which we mean one that is run by a belt from the crank shaft, or some other convenient shaft, is the best, for in that case the efficiency of the engine is utilized in pumping the water, for here the steam is used expansively, which is more than can be said of either the steam pump or the injector. The objection is sometimes made to the power pump that its speed cannot be regulated to suit the requirements of the boiler, but this objection is unwarranted.

When a manufacturer buys a lathe and sets it up, he does not belt from the line shaft directly on to one part of the cone pulley on the lathe, and then claim that there can but one kind of work be done on it, because it can only be run at one speed, but he proceeds to put up a countershaft with another cone pulley on it, and then he has several speeds at his command, and may use the one best adapted to the work to be done. There is no good reason why a power pump should not be fitted up in the same way, and thus be enabled to deliver a quantity of water suited to the amount needed. Then with an injector to use when the engine is at rest, it will be impossible for an ignorant or careless engineer to pump cold water into the boiler at any time.

The heating plant of the present day is usually so fitted up that the water of condensation is returned to the boilers automatically, and while there is sometimes an engine or pump used which exhausts into a heater that is used to heat the water necessary to make good the loss through drips, blowing down the boilers, etc., still there is no provision made for pumping this water of condensation through the heater should it be advisable to do so. Let us see what the consequence is. The plant is shut down at night with the coils and radiators full of steam, which condenses and falls to the lowest point possible. In the morning the pump is started up, and all of this water, which is now quite cold, is pumped directly into the boilers. This causes unequal contraction of the plates, and brings more stress to bear on them than any steam pressure which would be used could cause, and so they are strained, and some lively leaks possibly developed. If they fail under such abuse, wrecking the plant and killing the men, lack of water is given as the only cause, and the engineer who may be among the slain is blamed for the disaster, and he can no longer speak in his own defense. The piping should be so arranged that this water can be pumped through the heater, and some provision made for putting live steam into it to warm the water before it enters the boilers. The economy of the plan, so far as fuel is concerned, is no part of the question. It is claimed by some engineers that when water is used over and over again for making steam, a part of the economy of the scheme is offset by the fact that it requires more coal to evaporate this water than it would to take fresh water. But however this may be, it is certain that this water will not coat a boiler with scale, which is a very great consideration. Such water sometimes contains oil from the engine or pumps, but if a good oil and grease extractor is used a very large part of it may be eliminated. Sometimes when a grease extractor is used it is not effectual, because the drip is not properly attended to, thus allowing the apparatus to fill with water, when it becomes practically useless. If drips from such appliances are kept wide open, much steam will be wasted, and if shut, it prevents them from working as they were intended to, so that it is well to see that they are carefully adjusted to avoid either extreme. These drips are of course left open when the plant is shut down, and as the steam condenses, air is drawn in through them to fill the vacuum so formed. The next morning the steam is admitted with a rush, so that the air valves cannot let all of the entrapped air escape, and so some of it is mixed with the steam. If we open our safety valve on the hot water receiver we find that air is discharged, but still it is quite possible that some air is pumped back into the boilers, which will equal or exceed the amount that the water contained before it was evaporated the first time.

Grinding Reamers and Milling Machine Cutters.

By Tecumseh Swift.

I don't know whether everybody "caught the idea" embodied in the universal relieving lathe described and illustrated in the American Machinist August 8th. In the succeeding number we had something interesting about the reamers used in the shops of the M. C. Bullock Mfg. Co., for finishing the bores of the cylinders of the Willans engines. It is not everyone who will see any very intimate connection between the two articles. I can probably wed them by a single sentence. The Willans engine article referred to suggests several ideas about reamers in general, and the universal relieving lathe seems to suggest a grinding machine for the teeth of reamers and milling cutters that will grind them more correctly than they are generally ground at present. As far as I know at this writing these cutting teeth are nowhere ground in a way to give them the proper clearance angle, or in a way to enable them to do the best work or to keep in condition the longest.

For a light scraping cut upon a plane surface, as, for instance, with a broad, flat-nosed tool upon a planer or shaper, we have only to consider the angle of the cutting face and the clearance angle. The face of the cutting tool is usually nearly at right angles

to the surface to be cut, and this angle is generally used for the faces of reamers and milling cutters, so that there is nothing to be said about that. The clearance angle for planer tools has also been pretty well determined. The angle should be as small as possible. Probably it has never been determined how acute the angle should be if there be actually some clearance. This small clearance angle is essential to the tool to sustain the front or cutting face of it against the pressure of the metal it encounters, and, also, as the acuteness of the clearance angle of the tool with reference to the work means obtuseness of angle with reference to the cutting face of the tool, and as the more obtuse the angle of the tool the cooler will the apex of it be kept when it is subjected to the friction of cutting, the acuteness of the clearance angle is of value in this regard. An acute clearance angle also is of use often in preventing chattering, as without much clearance it would be impossible for the cutting edge to descend into the hollows of pronounced chatters. The surface of the work upon the planer or shaper adjacent to the clearance face of the cutting tool being flat the clearance face of the tool also should be flat. For cutting internally cylindrical surfaces, as with reamers or milling cutters, the clearance faces, in order to keep the clearance angle as acute as possible, should conform to the surfaces contiguous to them as nearly as possible, or, in other words, the clearance faces of these tools should be convex as opposed to the concave surface to be cut. For externally cylindrical surfaces the clearance face of the tool does not need to be concave, because if it is flat instead it can be still swung towards the work, making the angle at the apex as acute as may be desired without the heel of it coming in contact. But with an internally curved surface it is obvious that a flat or concave surface upon the cutter will not permit a very acute clearance angle. This is where our practice in grinding reamer teeth and the teeth of milling cutters is evidently incorrect. When every consideration seems to say that the surface should be convex our practice is to make it concave. It must be evident that it is impossible to get a clearance angle as acute as it should be with this concave surface for the clearance face. The teeth must wear away faster than they would with a more efficient support, and in the case of reamers it must be more easy for the teeth to cut too large a hole, or to cut too freely, or even to chatter while they remain sharp. We recognize the objection by making the surface to be ground on the teeth as narrow as possible, but still the back edge of it must clear the concave surface that it treads against, and if the heel clears it is certain that the cutting edge must have more clearance than it should have, and in consequence it will not do its work as well as it might, and it will wear away more quickly than it should. The ready adaptability of the universal cutter and reamer grinder in general use is heavily discounted by the uncertainty of its adjustments. The clearance angle that is given to the cutting edges of cutters is generally determined by avoiding the cutting edge of the following tooth and by scarcely any other particular. The grinding wheel in all our grinders, as far as known, runs in the wrong direction. The cutter or reamer is mounted to revolve freely and is turned to bring the cutting face of the tooth that is to be ground against a gage or stop, and the grinding wheel turns in the direction to press the tooth upon the gage.

The wheel running in this direction is more likely to overheat the edge and draw the temper than if it ran the other way, and it does not leave the cutting edge as good for cutting. There is certainly a difference in the ultimate edge and in the cutting and lasting qualities of a tool that is ground, or at least finished with the wheel running towards the edge or running with the wheel away from it. The universal relieving lathe that is especially designed for "backing off" or shaping the clearance faces of milling cutters gives the right movement also for grinding and finishing these faces, and in it the grinding wheel could, of course be mounted and made to run in the proper direction, and we would then have a better cutter and reamer grinder and better cutters and reamers than we have now.

Some Points About Experimental and Special Work.

The cost of work largely depends on how it is placed in our hands. Clear and detailed orders can be promptly and economically carried out, while vague directions generally result in excessive cost, and loss of time.

We cannot too strongly urge our customers to either make, or have us make, detailed working drawings before we are asked to bid on work.

We cannot undertake work without drawings, unless it is of the simplest kind.

The drawing board is a cheap place to experiment on. All points cannot be determined on paper, but we are safe in saying that what costs one cent to draw, will cost one dollar to dig out of the solid in the shop.

There is this advantage in having us make detailed drawings, namely, that we can make them conform to our system of manufacture, thereby avoiding much confusion and greatly expediting work.

When working from drawings sent us, we will be guided by figures only. We do not allow our men to put their scales on a drawing.

We guarantee the workmanship to be first-class in every way, and if we furnish the material it will be the best of its kind; but under no circumstances will we guarantee the satisfactory working of any mechanical device, unless by special bargain.

If flaws develop in material sent us to finish, making our work useless, we charge the cost of bringing the new material to the state of finish of the abandoned piece, at day's-work prices.

All measurements are supposed to be in inches and fractions thereof, unless otherwise specified, and we will use our judgment, in absence of instructions, as to how close the work is to be brought to gage.

If errors develop in work due to drawings not made by us, we make such errors good at the expense of the customer, but use great care to point out errors in drawings and to avoid mistakes therefrom.

We study to economize for our customers by using standard screws, gears, shafts, pulleys, pins, etc., wherever possible.

A very small change in size or form of an article cannot usually be made without much greater expense than is at first sight apparent. Even altering a screw is likely to demand new jigs and gages, and may create confusion and waste.

The cost of making a single article bears no proportion to that of making a large number. What costs dollars in one case may cost but a few cents in the other.

It is impossible, generally, to deliver part of a large order without adding greatly to the cost of those pieces first delivered, and delaying the final delivery of complete order.

To obtain steel or malleable iron castings, not less than twenty-one days must be allowed.

Cast-iron in small quantities and of simple forms can be had in as short a space of time as twenty-four hours.

Brass can be often obtained in three hours, and one day generally is all that is required to get even large castings.

Forgings if not very large can be obtained in a few hours.

Odd gears are very expensive and require from two to three weeks to get out, as cutters have to be made. Special forms milling cutters require about a week if not complicated.

Pattern work requires much time, and small pieces never should be gated if wanted in malleable iron or steel, as foundries prefer to do this themselves.

Drop forgings are only economical when wanted in large quantities, as it takes weeks to make dies and they are very expensive.

All jigs and special fixtures made for a job are charged for at the regular rates unless otherwise agreed.

We never insure work in progress unless directed so to do, and then only at the expense of our customers.

On experimental work, we render weekly statements and expect payment of same on the first of the following week.

We cannot take work from strangers without a deposit, and when this is exhausted we suspend operations until further funds are furnished.

We do not hold ourselves responsible for goods, once they leave our shop, except in so far as to see they are placed in responsible hands.

We have taken the liberty of republishing the above from the catalog of W. D. Forbes & Co. because it shows one concern's method of dealing with a class of work regarding which misunderstandings frequently arise. Their object in printing it in their catalog is, of course, to avoid these misunderstandings so far as possible. The points brought up are well worth consideration by all who have to do with such work, and they might be discussed with profit.

New Cause of Fly Wheel Failure.

A friend in Pittsburg sends us a clipping from the Pittsburg *Despatch*, which reads as follows:

The bursting of a fly wheel in the South side mill of the Oliver Iron and Steel Company was almost miraculously attended with no loss of life and limb, although the pieces of the broken wheel were scattered a distance of over a third of a mile. The casualty was one of those for which no adequate explanation is afforded; about the only theory suggested being that it was due to contraction caused by the cold last night. If there is any foundation for this theory, it would seem to suggest rather strongly the importance of running wheels slowly in cold weather, or warming them up before they are started.

Our friend inquires, "Don't you think the man who wrote that needs 'warming up' a little himself?" We do.

Alabama Iron for Steel Making.

A press dispatch from Birmingham, Ala., dated August 28th, says:

The discovery that low silicon or basic iron suitable for steel making can be made from ordinary red ore, which abounds hereabout, resulted to-day in the receipt of an order by the Tennessee Coal, Iron and Railroad Company from the Carnegie Steel Company, of Pittsburg, for 25,000 tons of this iron to be used in steel manufacture. The iron, which can be made as cheaply as ordinary pig-iron, will be shipped as rapidly as it is turned out. All of this will greatly hasten the construction of steel plants in this district.

Remarkable Submarine Work.

The steamer "Alva" was recently sunk in the St. Mary's River, having been struck by a whaleback whose nose penetrated her starboard quarter just aft of the engine room gangway and left a hole nearly 16 feet square. If the hole had been on the flat side of the vessel it would have been a comparatively simple task to cover it temporarily with timbers and canvas, but at the turn of the stern it was a more difficult thing to do. Dynamite was first used to clear away the wreckage preparatory to applying a patch. Dynamite was applied to individual rivets both for knocking off the heads of the rivets and for driving the rivets out of the holes. Then divers took down templates and marked the holes, and timbers were prepared with holes all ready to correspond and lag screws in the rivet holes held the timbers in place. The timbers were also edge bolted, and when all was adjusted the steamer was pumped out and proceeded in safety with her load of ore to South Chicago, using only her own siphon to take care of the leakage.

The Lee Gun Purchased by the Navy.

It is announced that the Navy Department has purchased of Mr. Lee the right to manufacture his shoulder gun, which we have previously mentioned. The price mentioned is $20,000, Mr. Lee giving a bond for an equal amount to protect the department in case it should transpire that the Lee Arms Company has any claim or rights in the patents. It is understood that the various small arms manufactories will be asked to bid for the construction of 10,000 of the new rifles.

One of the most novel uses of machinery, perhaps, is to be found at Coney Island, near New York, where a small lake has been formed, and, rising from its margin is an incline perhaps a hundred feet high, up which flat-bottomed boats are drawn by an endless chain, and allowed to shoot down upon smooth rails. By the time they reach the foot of the incline a very high velocity is attained, and when the water is reached there occur a series of rebounds that give an entirely new sensation to the passengers, and are well calculated to counteract the effects of a disordered liver in both passengers and spectators. Cars are also drawn to the top platform by cable, while a steam pump furnishes a supply of water, which, running down the incline, gives the similitude of a running stream. Machinery does about all the work, and evidently furnishes a great deal of genuine amusement.

The shipment of steel rails from the new Johnson plant at Lorain, Ohio, by boat all the way to New York, *via* Lake Erie and the Erie Canal, is an important step probably, and will open up a new field of usefulness for the canal, for it is probable that Cleveland, Buffalo, and other manufacturers will adopt the same means of reaching New York and Brooklyn with shipments that can take the required time.

Secretary Angus Sinclair, of the American Railway Master Mechanics Association, announces that examinations of candidates for scholarships of the association will begin at Stevens Institute, Hoboken, N. J., September 16th. Candidates wishing to be examined at Chicago may make special arrangements by communicating with President Morton, of the institute, and certificates of eligibility will be furnished by applying to the secretary of the association, 256 Broadway, N. Y.

A company has been formed in England, which proposes to insure owners of machinery in all kinds of workshops against its partial or complete breakdown. Mr. A. B. W. Kennedy, F. R. S., President of the Institution of Mechanical Engineers, is consulting engineer to the company.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9″ × 12″, 6″ × 9″ and 4½″ × 6″. We recommend the 6″ × 9″ size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The New Era Iron Works Co., Dayton, Ohio, send us a catalog illustrating and describing their new era gas and gasolene engines. These are made in various sizes, adapted to various kinds of service. The catalog is sent to those interested on application, and is 3⅜″x6⅛″.

The Prentiss Tool and Supply Co., 115 Liberty street, New York, send us a catalog devoted especially to the illustration and description of machinery adapted to bicycle manufacturing, including lathes of various types, screw machines, milling machines, drill presses, grinders and special machines made for bicycle manufacturing. The catalog is 8⅜″x11¼″.

The Bath Indicator Co., of Hyde Park, Mass., send us a small catalog devoted to the illustration and description of the Bath compound test indicator, an illustration of which we published in a recent issue. The catalog shows a variety of applications of this tool, and will be found of interest to machinists generally. It is sent to those interested on application, and is 4½″x6⅜″.

The Ransome Subway Co., Monadnock Block, Chicago, Ill., send us a catalog illustrating and describing their monolithic subways for sewers, electric conduits, drains, cable and electric roads, etc. These are made on what is known as the Ransome system, the special advantages of which are set forth in the catalog, which will be sent to those interested on application. The catalog is standard size, 6″x9″.

A new edition of the well-known catalogs of the Brown & Sharpe Mfg. Co. and of Darling, Brown & Sharpe has been issued. It contains 366 pages—60 more than its immediate predecessor, and these extra pages and the changes made in the others make it desirable that this new edition should take the place of former ones. Additional tables and other matter have been added that increase its value as a mechanics' reference book, and as it is the wish of the makers that it may be found in every mechanic's tool chest or drawer it is sent by them free to any address upon application. It is 3⅝"x5⅞".

MANUFACTURES

The Forsyth (Ga.) Mfg. Co. will shortly build an additional mill to cost $100,000.

The Watertown (N. Y.) Steam Engine Co. have increased the salary of their 200 employes 10 per cent.

The Emerson Mfg. Co., of Rockford, Ill., has been incorporated with $200,000 capital by Chas. S. Brantingham and Edward P. Lathroy.

The Mt. Carmel (Pa.) Iron Works has been formed with a capital of $20,000, by David Coup, Holden Chester and others.

The Tinkham Cycle Co., of New York City, has been incorporated, with $100,000 capital. Julian R. Tinkham is president.

The Keystone Axle Co., of Baltimore, Md., has been formed by D. A. Clark, J. T. Rowley, Thos. R. Torrence and others, with a capital stock of $150,000.

The Reliance Milling Co., of Murphysboro, Ill., has been incorporated by Charles H. Clay. John H. De Lano, Sr., and George Williams, Sr., with a capital of $20,000.

A new company has been organized with a capital of $100,000, at Elizabeth City, N. C. They will erect a new cotton-mill 300x100. O. McMullen is president.

The Wright Company, of Lowell, Mass., has been organized with a capital of $25,000. The officers are E. W. Lovejoy, president; W. A. Wheeler, vice-president; W. H. Russell, treasurer and A. L. Wright, superintendent.

The Mount Vernon and Terre Haute Construction Co., of East St. Louis, Ill., has been incorporated with a capital stock of $5,000 to construct railroads, bridges, etc. The incorporators are Wm. S. Carter, Daniel C. Taylor and Elenelous Smith.

Machinists' Supplies and Iron.

NEW YORK, August 31, 1895.

Iron—American Pig—We quote standard Northern brands, $14 for No. 1; $13 for No. 2; $12.75 for No. 2 Plain, and $12.50 for Gray Forge. Southern brands, $13.50 to $14 for No. 1; $13 to $13.25 for No. 2; $12.50 to $12.75 for No. 3; $13 to $13.25 for No. 1 soft; $12.75 to $13 for No. 2 soft; and Foundry No. 4, $12.25 to $12.50

Antimony—Business fair and prices steady; Cookson's, 8c. to 8½c.; Hallett's, 7½c. to 7¾c.; Japanese, 7c.

Lard Oil—Prime City, 50c. to 51c.

Copper—Lake, 12¼c.; Electrolytic, 12c.; Ordinary Casting, 11⅝c. to 11¾c.

Lead—Market unchanged, 3.52c. for round lots, and 3.55c. for single carloads.

Spelter—Prices have slightly advanced. Good Western, 4.27½c.

Tin—Prices have advanced about ¼c., quotations now ranging from 14.30c. to 14.35c. for round lots.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS.

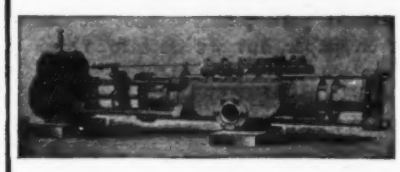
On and after July 4th this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—Bright, active machinists to canvass for subscription to AMERICAN MACHINIST, liberal commission. Address, with refs., Subscription Dep't, AMERICAN MACHINIST, 203 Broadway, N. Y

Foreman patternmaker, thor. in all its branches, desires to make a change. Box 95, AM. MACH.

(*Continued on Page 713.*)

THE DEANE OF HOLYOKE MINING PUMPS.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

Write for "The Deane Specialties."

BUFFALO BLOWERS, UNEQUALLED EFFICIENCY, DURABILITY, MINIMUM POWER. BUFFALO FORGE CO. BUFFALO, N.Y. U.S.A.

BUFFALO BLACKSMITH TOOLS. PUNCHES, SHEARS, DRILLS, HAND BLOWERS, FORGES, ETC. BUFFALO FORGE CO. BUFFALO, N.Y. U.S.A.

FINE TAPS AND ADJUSTABLE TAP WRENCHES.
SEND FOR CATALOGUE.

Wiley & Russell Mfg. Co.
Greenfield, Mass., U. S. A.

Crescent Steel Co.
STEEL of remarkable purity and strength for costly tools and dies.
PITTSBURGH, PA.
CHICAGO, ILL.
NEW YORK, N. Y.
NO BETTER MADE ANYWHERE.

WANTED, A MANUFACTURING CONCERN

With first-class facilities, capable of building machines weighing from three to twelve tons. Must be fitted to handle a large continuous business and financially able to carry out agreements. Machines are of high grade.

Address Box 90, care of American Machinist.

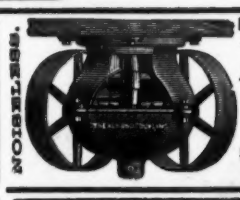
Keep a keen edge on your brain
by reading the best books

"THE MODERN MACHINIST," by John T. Usher, is a new book just out. It is written by a practical man, in a practical manner, for practical machinists. No finely spun theories, but a plain, common-sense talk about the best ways to do difficult work. It gives many new wrinkles, and has 257 entirely new illustrations, which show just how to do it

Price, $2.5c, by mail

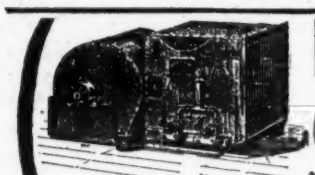
Illustrated circular, giving full particulars; also Catalogue of Books for Machinists and Engineers, sent free

NORMAN W. HENLEY & CO., Publishers
132 Nassau Street
Vanderbilt Building NEW YORK



The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, MFR.,
83 and 85 Washington Street,
BROOKLYN N. Y.

WRIGLEY'S EMERY WHEEL DRESSER
SENT ON TRIAL
To be returned or paid for in 30 days. It faces rapidly or cuts V grooves and all Shapes. Cutters Never Get Dull—Are Self-Hardening. Has Hardened Steel Bushings at Pin Bearings. Price, $2.00; Cutters, 15 cts. per set. Send for Circular.
T. WRIGLEY, 85-87 Fifth Av., Chicago, Ill., U. S. A.



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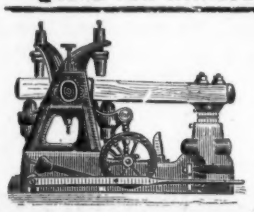
VENTILATING, DRYING, HEATING.
GARDEN CITY FAN CO.
MANUFACTURERS OF EXHAUST FANS, PRESSURE BLOWERS, ETC.
SEND FOR CATALOGUE E. CHICAGO, ILL. U.S.A.

GRANT GEARS

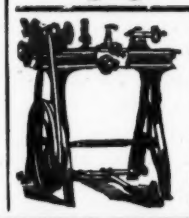
Ready Made Iron Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
1895 Gear Book, Free.
Treatise on Gears, $1.00.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.,
and 86 Seneca St.,
Cleveland Ohio.



BRADLEY HAMMERS.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a Bradley Hammer will soon pay for itself by what it will save over any other similar tool. Helve, Upright and Strap Styles. Send for circulars.

THE BRADLEY COMPANY,
SYRACUSE, N. Y.



Star Foot-power Screw Cutting Lathes Automatic Cross Feed
9 and 12 inch Swing.
New Designs. Novel Features.
Send for Catalogue B.
SENECA FALLS MFG. COMPANY
687 Water St., Seneca Falls, N. Y.

The fact that 140 railroads are now using our reducing valves for heating their passenger cars, ought to be a sufficient guarantee for the goods made by
THE MASON REGULATOR CO., Boston, Mass.

Kent's Mechanical Engineer's Pocket Book.
1064 pages 12mo. Morocco - - - $5.00
JOHN WILEY & SONS, New York City.

DO YOU USE FORGES?
IF SO
BUY THE STURTEVANT FORGE.
Send for Catalogue No. 77—50 Pages.
B. F. STURTEVANT CO.
BOSTON. NEW YORK. PHILADELPHIA. CHICAGO. LONDON, ENG.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.

ARE YOU LOOKING
for a lathe? We are building them in various sizes from 9 in. to 24 in. swing, in various lengths, both engine and speed lathes. Our designs are the **latest**, while the **workmanship, material** and **finish** are of the **highest** order. Our catalogue will tell you all about them as well as of our planers, shapers and other tools.
SEBASTIAN LATHE CO.,
117 and 119 CULVERT ST., CINCINNATI, OHIO, U. S. A.

BORING AND TURNING MILLS
ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.
We have a variety of sizes and a large stock for immediate shipment.
THE BULLARD MACHINE TOOL CO.,
E. P. BULLARD, Pres't. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.

H. W. JOHNS'

ASBESTOS SECTIONAL PIPE COVERINGS.
NON-CONDUCTING COVERINGS FOR STEAM AND HOT WATER PIPES, BOILERS, ETC.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y.
JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, LONDON

Mechanical draftsman, 29 years old, good practical experience, wants position. A. H. G., AM. MACH.

Wanted—Situation as general foreman or superintendent of high-speed engine shop; at present supt. of shop. "D. A.," care AM. MACHINIST.

Wanted—Position as superintendent, foundry and machine business, 20 years' exp. in general work. Address BOX 97, AMERICAN MACHINIST.

Mechanical draftsman with technical education, shop and office experience, wants position. Address BOX 68, AMERICAN MACHINIST.

Experienced Designer Wanted—Familiar with all classes of bookbinders' and paper-cutting machinery, for the West. Address, stating all particulars, "A," care of AMERICAN MACHINIST.

Situation Wanted—Cupola tender, ex-melter, light & heavy castings, also for metallic bedsteads; running two heats per day in England and U. S.; refs. G. Yeates, 2766 Jasper St., Philadelphia.

Mechanical engineer, graduate and experienced draftsman, would like pos. as inspector, assistant sup't or draftsman in machine shop (steam engine or spec'l mach'y), Chicago pref'd. BOX 88, AM. MACH.

Draftsman, 27 years' old, 11 years' experience, 5 years' designing and originating automatic machinery, 3 years as chief draftsman working from 6 to 10 men, would like to change position. M. E. D., care AMERICAN MACHINIST.

Millwright, toolmaker, 35, recently owned small shop, experienced setting up machinery, shafting, repairs to lathes, planers, milling machinery, etc., making of small cutters, shell reamers, power hammer dies, etc., wants position. Vic., AM. MACH.

Wanted—By an Eastern machinery house selling largely engines, boilers, shafting and machinery, a resident agent in the city of Montreal. Reply, stating age, experience and salary to
BOX 86, AMERICAN MACHINIST.

Wanted—Position as instructor in machine shop of some school or university teaching engineering; applicant has had 13 years' experience as machinist and 7 years as draftsman. W. S. Leonard, Battle Creek, Mich.

Draftsman Wanted—An experienced young man familiar with Corliss and plain engine work, who has also had a good shop practice, where very economical methods of designing and manufacture are common; one capable of estimating and selling engines preferred; state salary which should be moderate & full particulars. Practical, AM. MACH.

Wanted—A superintendent to take charge of a brass factory who is thoroughly experienced in the mixing of metals and finishing of valves, cocks, etc., for steam and water service; for a good man who knows his business and can handle men there is a good position. Address BOX 87, AMERICAN MACHINIST.

Advertiser has been otherwise engaged of late and would like to correspond with parties in need of a foreman or man to fill other responsible position, as I wish to secure position in such capacity on or before October 1st; can furnish first-class references as to ability, etc.; or correspondents can refer to columns of the "A.M." and other journals, and to my recently published book, "The Modern Machinist." Address John T. Usher, 498 Third Avenue, New York City.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Best and cheapest Bolt Header made by C. H Baush & Sons, Holyoke, Mass.

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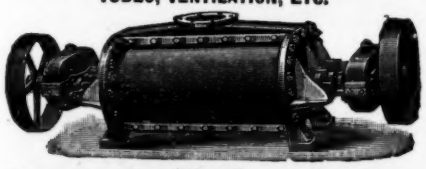
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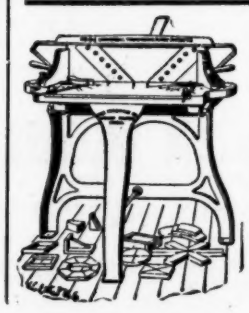
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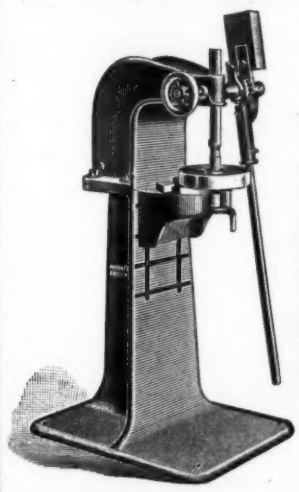
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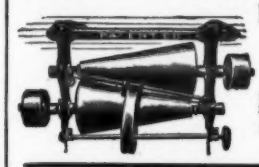
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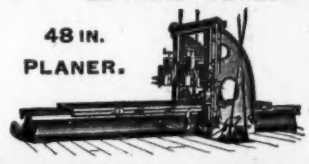

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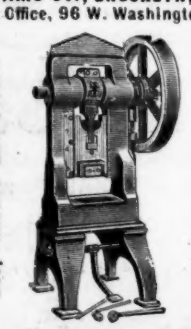

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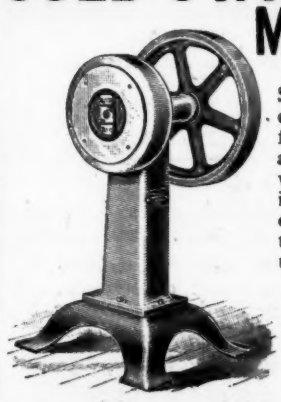

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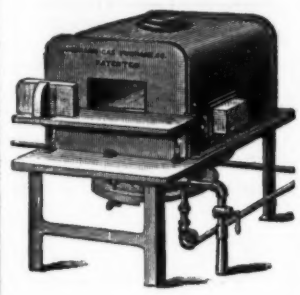

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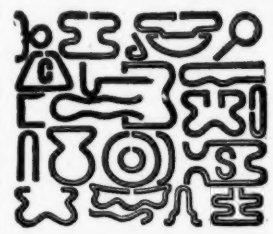

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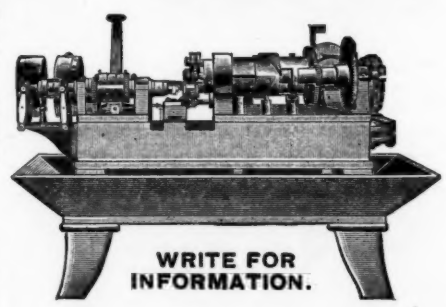

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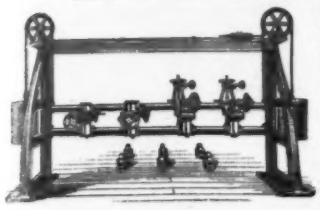
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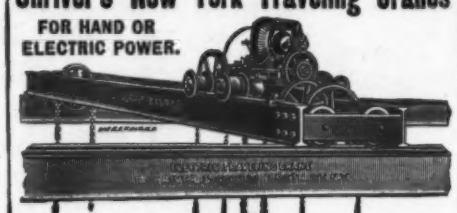
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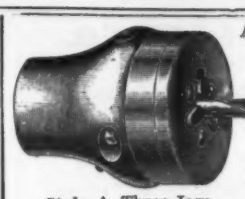
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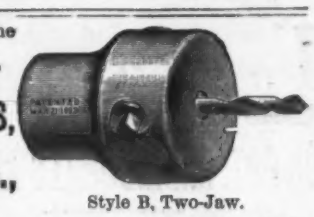
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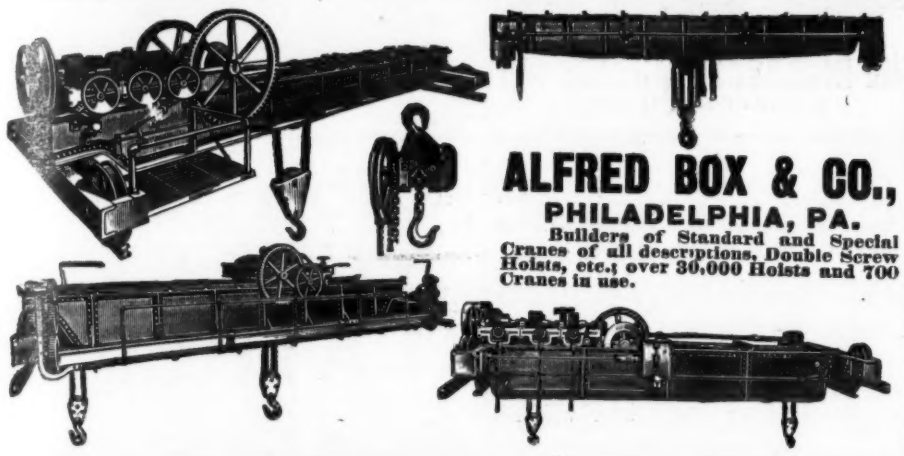
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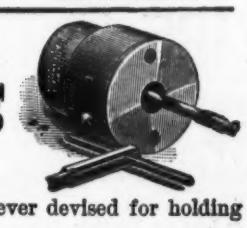
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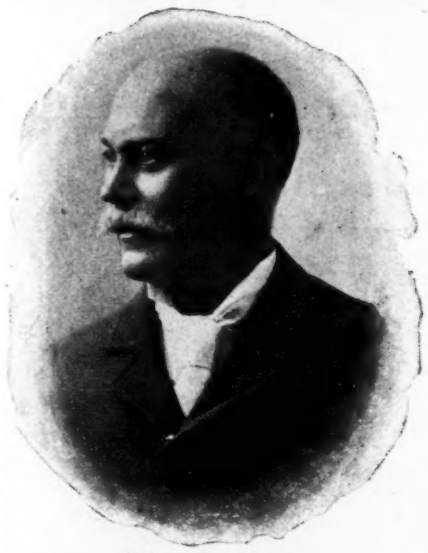
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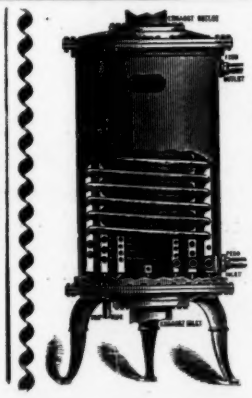
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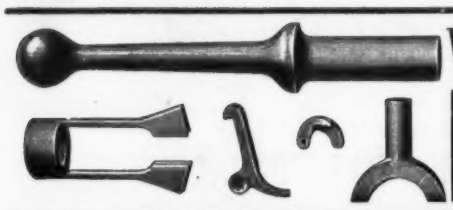

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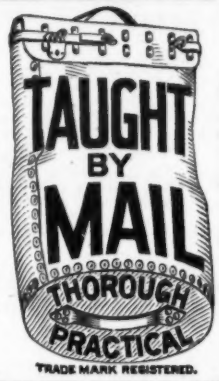

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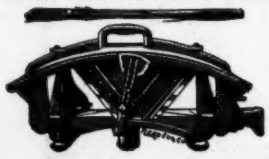

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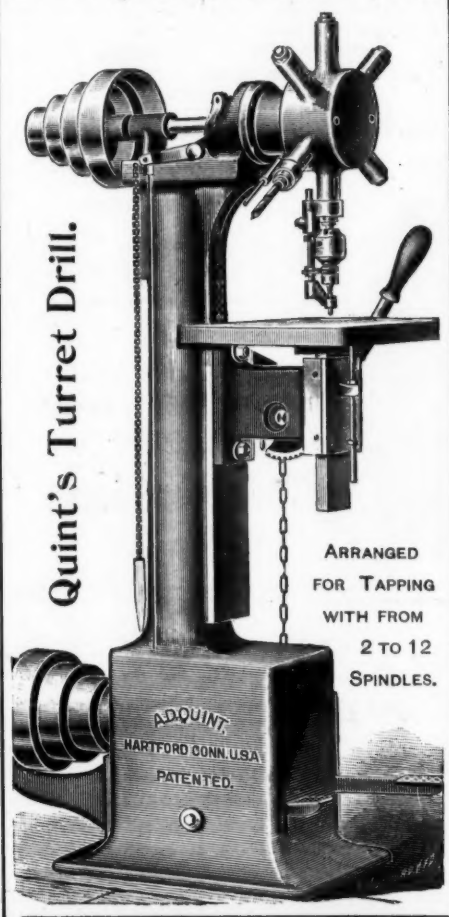

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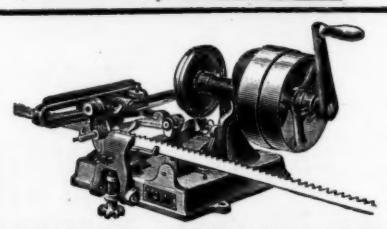

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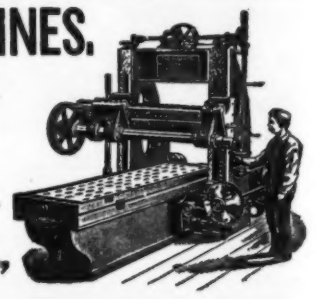

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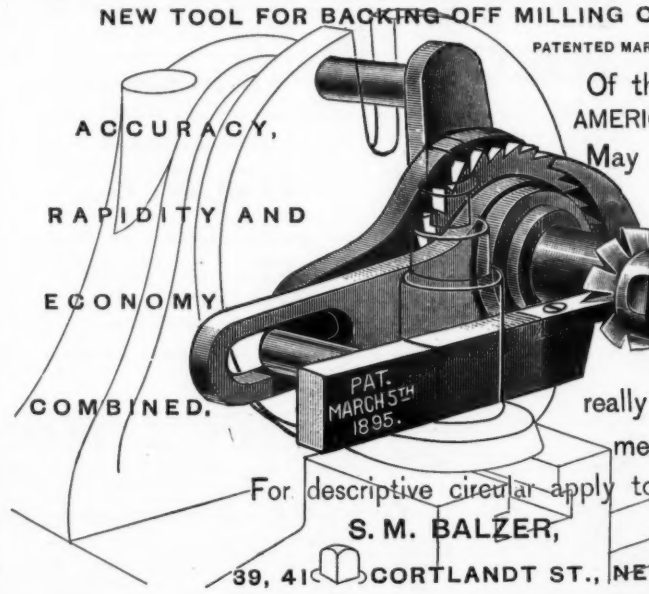

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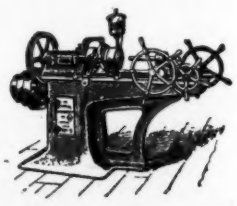

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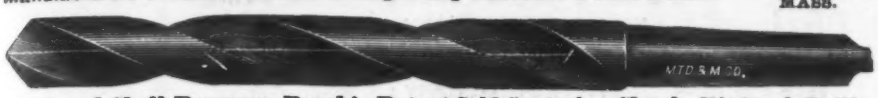

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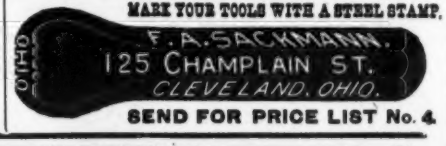

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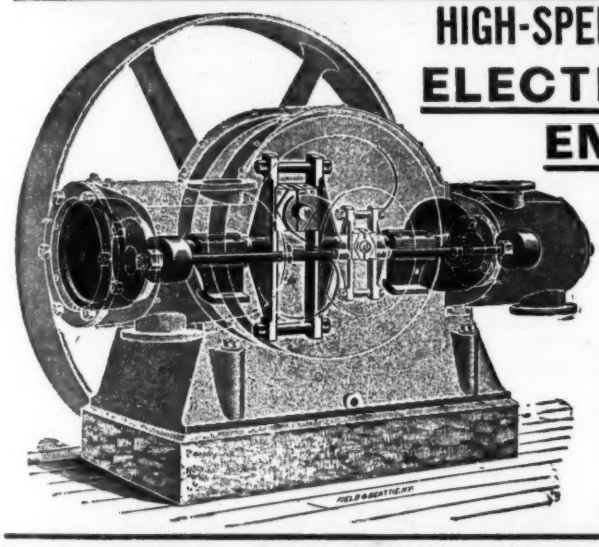

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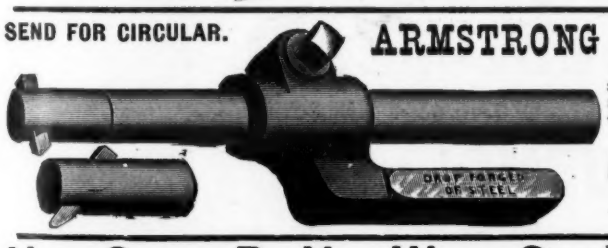

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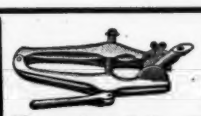

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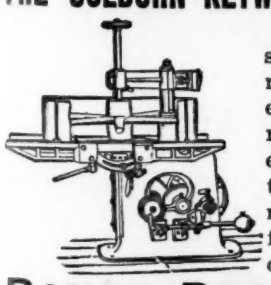

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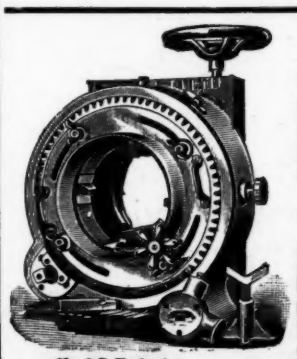

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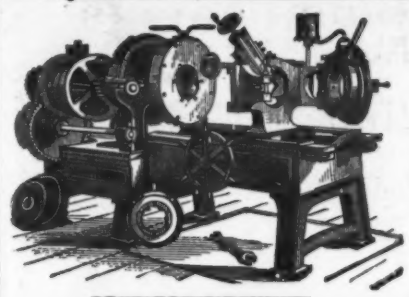

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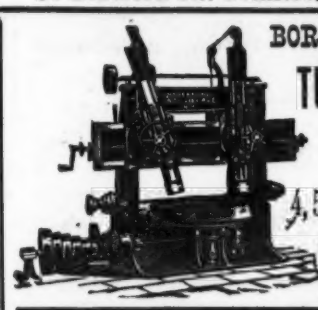

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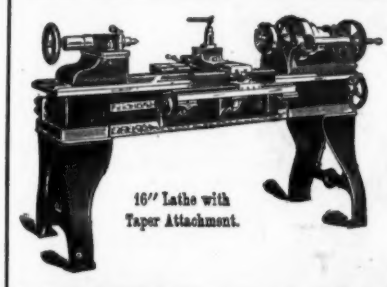

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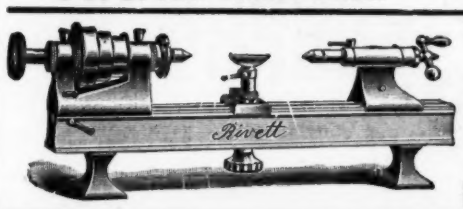

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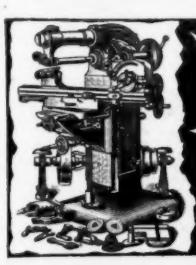

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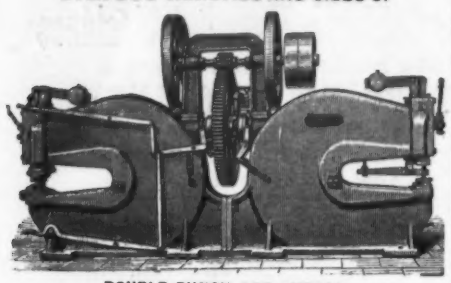

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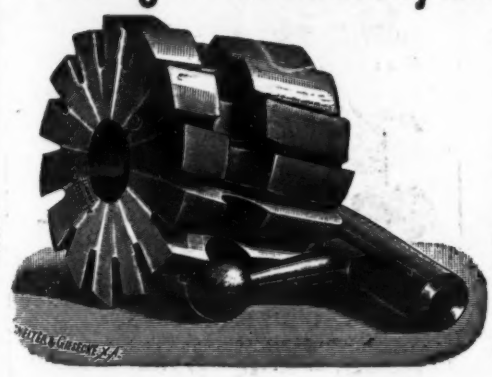

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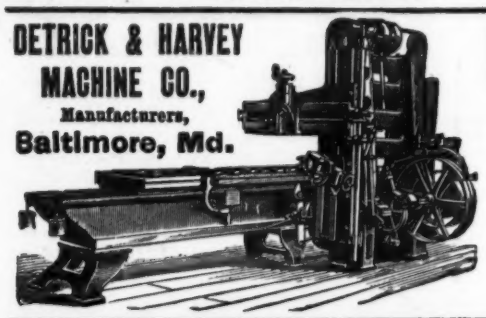

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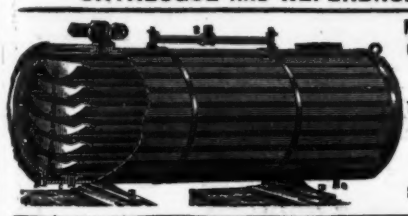

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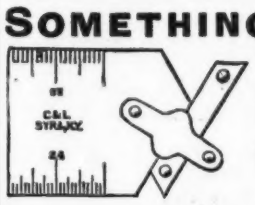

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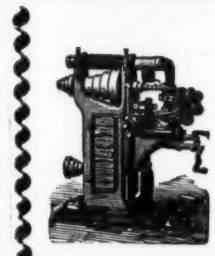

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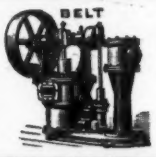

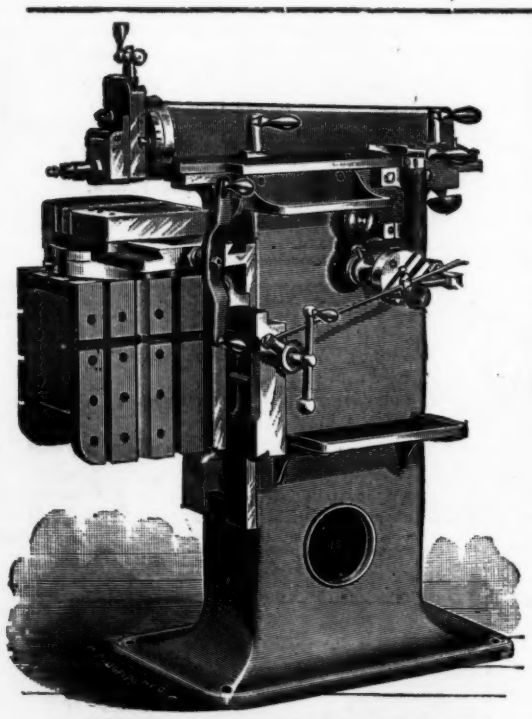

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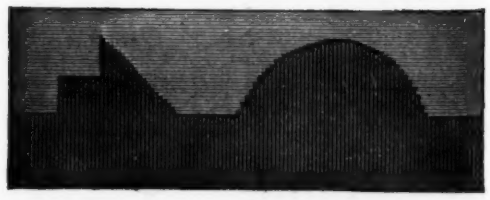

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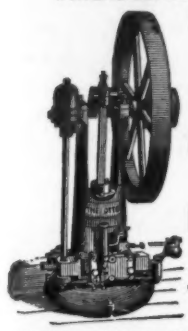

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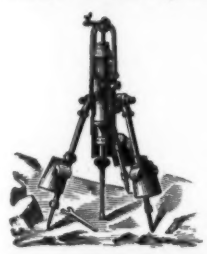

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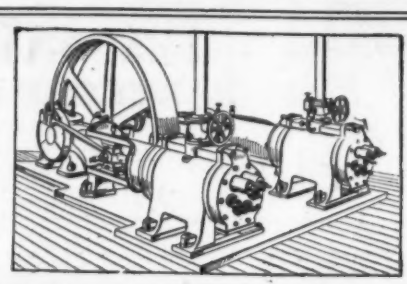

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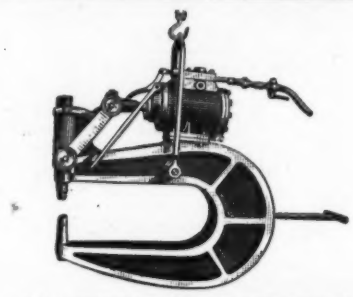

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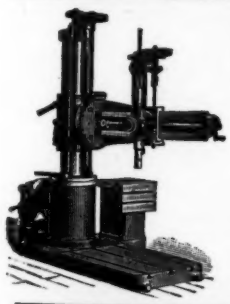

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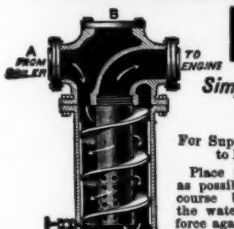

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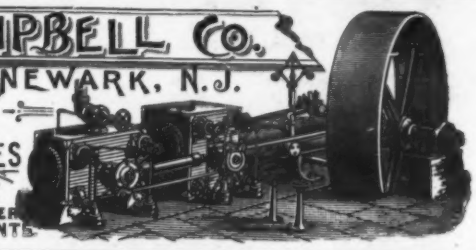

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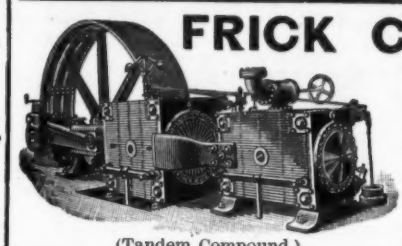

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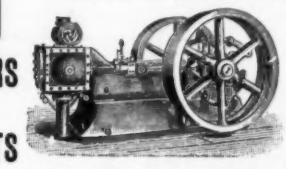

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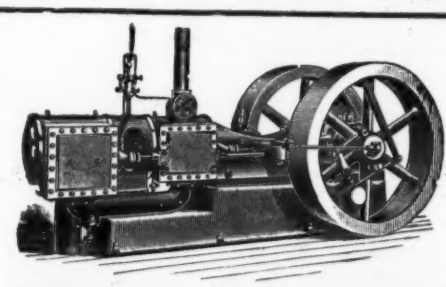

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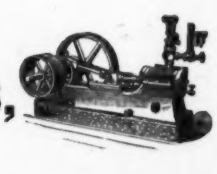

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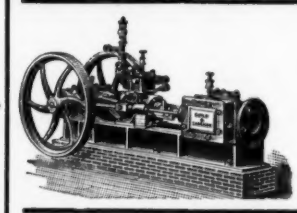

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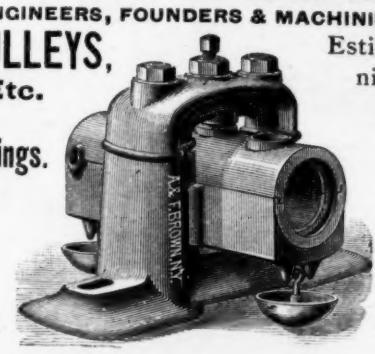

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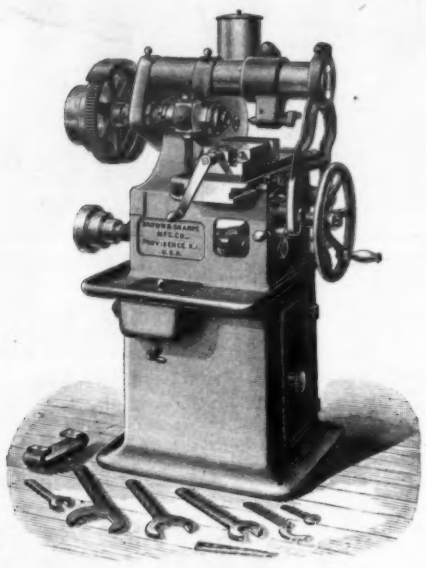

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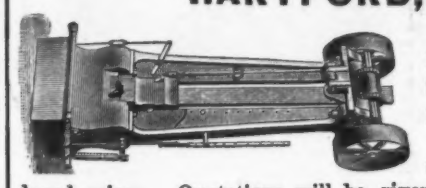

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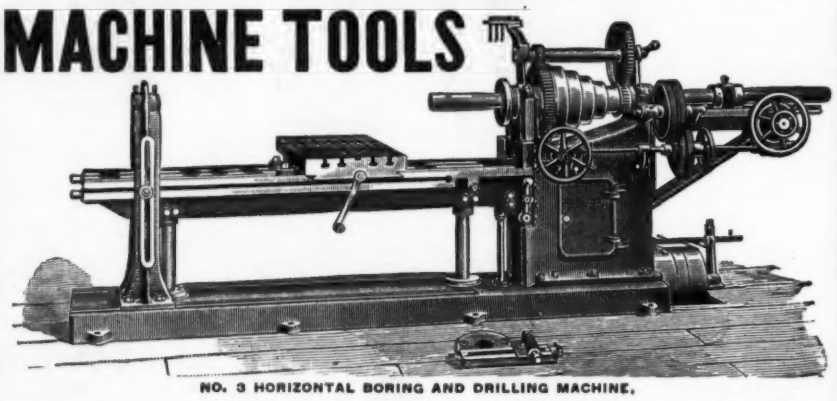

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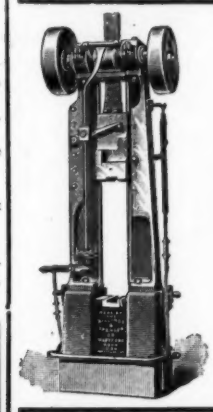

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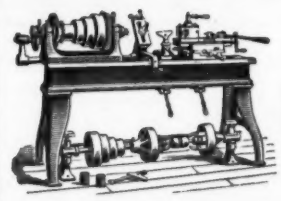

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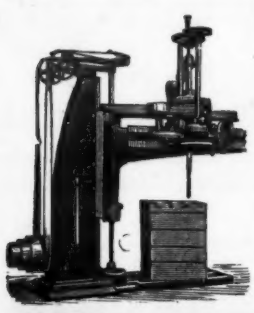

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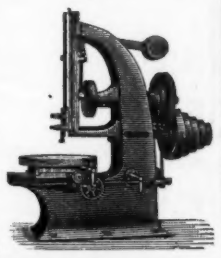

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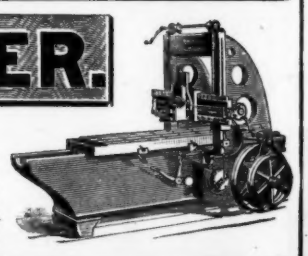

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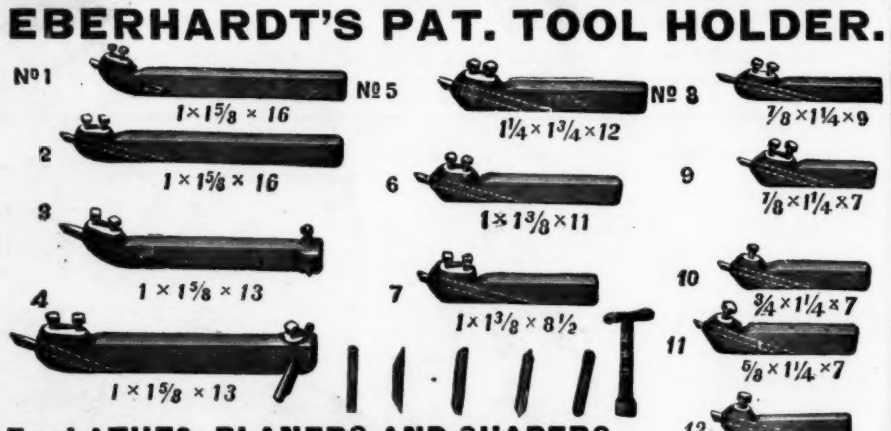

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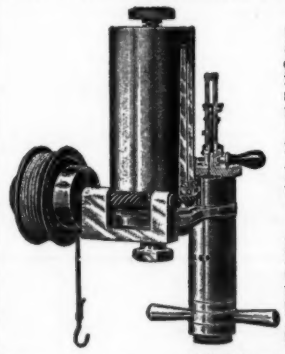

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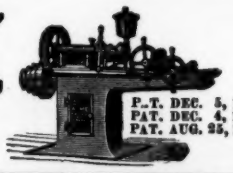

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